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Socio-economic Correlates of Fertility in Canadian Metropolitan Areas, 1961 and 1971

Census Analytical Study

Socio-economic Correlates of Fertility in Canadian Metropolitan Areas, 1961 and 1971

By Evelyne Lapierre-Adamcyk

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FOREWORD

The Canadian censuses constitute a rich source of information about the condition of groups and communities of Canadians, extending over many years. It has proved to be worthwhile in Canada, as in some other countries, to supplement census statistical reports with analytical monographs on a number of selected topics. The 1931 Census was the basis of several valuable monographs but, for various reasons, it was impossible to follow this precedent with a similar program until 1961. The 1961 Census monographs received good public reception, and have been cited repeatedly in numerous documents that deal with policy problems in diverse fields such as manpower, urbanization, income, the status of women, and marketing. They were also of vital importance in the evaluation and improvement of the quality and relevance of Statistics Canada social and economic data. This successful experience led to the decision to continue the program of census analytical studies. The present series of analyses is focused largely on the results of the 1971 Census.

The purpose of these studies is to provide a broad analysis of social and economic phenomena in Canada. Although the studies concentrate on the results of the 1971 Census, they are supplemented by data from several other sources. These reports are written in such a way that their main conclusions and supporting discussion can be understood by a general audience of concerned citizens and officials, who often lack the resources needed to interpret and digest the rows of numbers that appear in census statistical bulletins. For these persons, interpretive texts that bring the dry statistics to life are a vital dimension of the dissemination of data from a census. Such texts are often the only means that concerned citizens and officials have to personally perceive benefits from the national investment in the census. This particular report is one of a series planned to be published concerning a variety of aspects of Canadian life, including income, language use, farming, family composition, migration, adjustment of immigrants, human fertility, labour force participation, housing, commuting and population distribution.

I should like to express my appreciation to the universities that have made it possible for members of their staff to contribute to this program, to authors within Statistics Canada who have freely put forth extra effort outside office hours in preparing their studies, and to a number of other members of Statistics Canada staff who have given assistance. The Social Science Federation of Canada has been particularly helpful in the selection of authors for some of the studies, and in arranging for review of several manuscripts. In addition, thanks are extended to the various readers, experts in their fields, whose comments were of considerable assistance to the authors.

Although the monographs have been prepared at the request of and published by Statistics Canada, responsibility for the analyses and conclusions is that of the individual authors.

PETER G. KIRKHAM,

Chief Statistician of Canada.

PREFACE

This study of fertility variations among Canadian metropolitan areas forms part of the Statistics Canada Census Analytical Studies Programme. Jacques Henripin suggested an analysis of these variations through the use of census tract data, and I began the work in 1968 as a Master's thesis concentrating on the Montréal metropolitan area. From this time, the Census Division, through Dr. Karol Krótki, expressed interest in the study, and it was suggested that other metropolitan areas be included. In 1972 the present study, as part of the Census Analytical Studies Programme, began. Thanks to the initiative of Leroy O. Stone, I was able to complete the project at the Département de démographie, Université de Montréal.

It is with much gratitude that I thank Statistics Canada and its staff for the help they have given me during these years. The assistance of certain individuals was particularly valuable. Foremost among them are Mr. Leroy O. Stone, Senior Advisor on Population Studies and Statistics, Mme Frances Aubry and Mrs. Mary Dean. I acknowledge also the excellent work of Mr. Albert Daigen, translator, who prepared the English version of this work. Mme Yolande Lavoie read the manuscript and I wish to thank her for her comments.

I have benefitted from the support services made available to researchers at the Université de Montréal, particularly the administrative support of the Service de la Recherche and the services of the Centre de calcul. But it is particularly the generous hospitality offered me by the Département de démographie that permitted the completion of this study. I am very grateful to M. Jacques Légaré, head of the department, who assumed administrative responsibility for the project, and to M. Jacques Henripin who generously permitted me to upset the schedule of research duties he assigned to me in order that I might complete this study. Finally, I offer many thanks to Mlle Josée Laferrière who typed the text and Mme Lise Hamel-Robillard, programmer, without whose help use of the census summary tapes would have been very difficult.

To my husband and my children I offer a special "thank you". They cheerfully modified our family life when deadlines caused me to infringe upon the hours I normally devote to them.

To all who have encouraged me in the pursuit of this study, thank you!

Évelyne Lapierre-Adamcyk,
Département de démographie,
Université de Montréal
September 1978.

TABLE OF CONTENTS

TABLE OF CONTENTS - concluded

LIST OF TABLES

CHAPTER 1

INTRODUCTION

In his monograph on fertility, based on the 1961 Census of Canada, Henripin shows that fertility decreases as one moves along a continuum from rural areas to metropolitan areas. But he goes on to show that although the fertility level is lowest in metropolitan areas, it is not the same for all segments of their population. His classification of the population of metropolitan areas only, according to cultural and socio-economic characteristics, reveals many differences in fertility, though not so large as those found in rural or less urbanized environments.

Much research has been done, both in Canada and abroad, on fertility differences among individuals, but studies of fertility differences among areas of residence have been much less common. Because the demand for population forecasts for small areas is growing, and because traditional prediction methods have proven unsuitable for this purpose, it should be useful to examine the relationships between the characteristics of areas of residence and the fertility behaviour of their populations. Such an inquiry might reveal regular associations between specific areal characteristics and fertility and might thereby suggest ways of predicting fertility for smaller areas.

This study is intended to be a systematic examination of the relationships between the demographic, cultural, and socio-economic characteristics of census tracts and the recent fertility patterns of their populations. The data to be analysed were collected in seven metropolitan areas of Canada during the 1961 and 1971 Censuses.

The populations of large cities are often thought to be relatively homogeneous, but they actually display considerable differences in fertility. In 1961, for example, relative variation in the ratio of children aged 0-4 to married women aged 15-44 was between 20% and 35% in most metropolitan areas. Such surprising variability gives rise to the following questions:

1. Is there some association between a certain type of urban environment and the fertility of the people who live in it?

2. Given that environment and fertility are related through the socio-economic and cultural characteristics of an area and of its population, which variables provide the most satisfactory statistical explanation of this relationship?

3. Is the order of importance of these variables the same in all metropolitan areas?

4. Does the order of importance for 1961 also hold for 1971?

The purpose of this study is to discover associations between the characteristics of an environment and fertility within it. The environment in question is an area defined for census purposes, but this does not make it an artificial or an arbitrary unit, since homogeneity of population is a basic criterion used to define census tract boundaries. The census tract is an area that closely approximates the setting in which families carry on their lives and make decisions. Most important, it is within this setting that socio-economic factors make their influence felt. The fundamental hypothesis of this monograph will be that couples are affected by their environment (milieu), that it influences their decisions in such a way that we can observe a relationship between the characteristics of a given area and the aggregate results of the individual decisions made by its residents.

Several studies of the relationship between area of residence and fertility merit discussion at this point. The first two (Duncan 1964 and Rhodes 1971) show that differences in fertility are related not only to the characteristics of individual couples, but also to those of the environment in which they live. A second group of studies suggest which variables should be used to characterize this environment. In this regard, we also look at studies dealing with fertility differences in Canada in particular, so that all the variables relevant for this country can be included in our analysis.

Let us now consider the first two articles.

Duncan (1964) attempts to determine whether fertility variations according to place of residence in an urban area can be taken as proof of fertility differences according to socio-economic characteristics. To do so, he uses a

sample of couples classified by their individual characteristics and by those of the census tract in which they live. First it is shown that fertility tends to decrease as rent increases, whether couples are classified by the rent they actually pay or by the average rent in the census tract. Multiple classification analysis is used to show that when the effect of individual rent is controlled, there is a lower but still substantial variation in fertility according to average rent in the census tract. Duncan then introduces other factors such as the education of each spouse, age at marriage, region of birth, and home ownership. Adding these factors further reduces the variation according to tract rent, but does not eliminate it; furthermore, adding tract rent to all the other factors reduces the variation associated with them. Duncan concludes that not all of the variation related to tract rent can be explained by differences in individual characteristics, because this areal factor has significant "net effects" when all the individual factors have been taken into account.

In the second article, Rhodes (1971) deals with the same problem, attempting to determine whether average levels of income and education in census tracts explain variation in fertility beyond that accounted for by individual income and education. Rhodes, like Duncan, uses sample data for his analysis. First he shows that characteristics of the environment (in this case the census tract) are more weakly related to fertility as the age of individual women advances. From this he concludes that relationships between tract characteristics and the fertility of an older woman reflect the similarity of the various areas where the woman has lived.

Next Rhodes demonstrates that individual fertility in young wives is more closely correlated with the fertility level of their census tract than with their education or their husband's income. Multiple regression analysis reveals both individual and areal correlations and it is wrong to think one can be substituted for the other. According to Rhodes, the correlations observed for young wives probably reflect a certain amount of geographic segregation according to income, education, and the stage that couples have reached in their family life cycle. Is this segregation completely independent of fertility? Is there a milieu effect such that simply living in a neighbourhood where fertility is high leads couples to have more children? The results of the study, he says, suggest that since for women of a given age tract characteristics provide a more

accurate prediction of cumulative fertility (number of children ever born) than of current fertility (number of children under age five per woman), the association between tract characteristics and fertility probably reflects geographic segregation rather than the influence of the neighbourhood environment on couples' decisions.

An important conclusion can be drawn from the two studies just described: correlations exist at both the individual and the areal levels, and variation in fertility cannot be attributed solely to one or the other. Because some variation in fertility can be explained (at least in the analytical and statistical sense) only by areal characteristics, the present systematic investigation of the relationships between such characteristics and fertility should prove useful. The correlations between areal factors and fertility may reveal the causes of the fertility variations not accounted for by individual characteristics. Any attempt to infer associations at the individual level from those observed at the areal level remains risky, however, and should be made only with the greatest caution.

Turning to the second group of studies, we find that the authors, in attempting to uncover the relationships between area of residence and fertility, have used widely varying units of observation, ranging from whole nations down to census tracts. Heer and Boynton (1970) briefly review this literature and reaffirm a conclusion of Duncan, Cuzzort and Duncan (1961): the type of association observed at one level of aggregation will not hold at another unless the variability of the independent and dependent variables is the same at both.

The unit of observation for most areal studies of fertility correlates is relatively large and not very homogeneous. Those studies dealing with entire countries or subdivisions of countries are generally intended to relate fertility to the level of economic development and thereby to identify the factors influencing the rate of population growth. Examples of such research include work done by Heer and Turner (1965) on Latin America, by Friedlander and Silver (1967) on several countries at various stages of development, and by Collver, Speare and Lin (1967) on Taiwan; other studies of this type are cited in the bibliography. The data in these studies are analysed by means of conventional statistical techniques such as multiple regression and partial and multiple correlations. The variables most frequently considered are infant mortality, illiteracy, the size of the rural population, the rate of participation of women in the labour force, gross

national product, per capita income, population density, and geographic and social mobility; other social and cultural characteristics are also taken into account.

The principal weakness of these studies is that the variables do not reflect the distribution of the phenomena they measure. For example, two countries with the same national infant mortality rate could have very different rates at lower levels of aggregation. Conclusions based on an observed association between fertility and infant mortality at the national level might therefore be of little value (Kocher, 1973, page 73).

Now we will consider studies of socio-economic correlates of fertility in which the unit of observation is the city. In Collver (1968), the specific units are United States metropolitan areas as defined for the 1960 Census in that country. Collver finds a negative association between the labour force participation rate of women (married or unmarried) and several measures of fertility, but he concludes that this relationship cannot be interpreted casually. He states that it has only limited significance because the female participation rate depends more on the availability of jobs than on the willingness of women to work. Finally, Collver stresses that his findings cannot be regarded as applicable to all communities at all times.

Cain and Weininger (1973) attempt to identify factors that influence variations in fertility, using an economic model and data for United States metropolitan areas in 1940 and 1960. They find that fertility of wives in the areas considered is correlated positively with a male income but negatively with the average wage available to wives, a variable that reflects the industrial structure of the metropolitan area. Other, non-economic variables are included in the model, but the influence of the economic variables remains strong.

The last study in this group is by Stafford (1977) and deals with fertility trends in Canadian cities. The author concludes that fertility differentials among Canadian cities are related to the regional location of these cities; those with the lowest fertility are in Quebec and in the industrial region of Ontario. The other variables that Stafford considers (industrial structure, distance from major urban centres, average wage) do not seem to affect these

fertility differentials.

I have not found any recent studies of fertility that use the census tract as the unit of observation. The present study is thus an initial investigation of fertility correlates at this level. Since the census tract is a relatively small unit that approximates the immediate setting of family life, the tract characteristics measured should correspond to individual traits more closely than the characteristics of larger units would. Certain variables used in the studies described above, but not relevant for comparisons within metropolitan areas, will be excluded from this analysis; these are the percentage of the population living in rural areas, the industrial structure, and the degree of urbanization.

To identify the factors most likely to influence urban fertility in Canada specifically, we will now consider studies based on the Canadian Censuses of 1961 and 1971. The first and most important is Henripin's monograph, based on the 1961 Census. The author finds that the following factors affect fertility: type of environment (urban versus rural), level of schooling of husband and wife, religion of wife, income of husband, and mother tongue of wife. Henripin measures the specific influence of each variable by using cross-tabulations to control the influence of the others (this technique is available only because of the wide coverage of the census). The author does not determine whether all the observed associations hold within metropolitan areas, but he does find that the correlation between fertility and income holds in this type of environment (page 284).

In his profile study of data from the 1971 census, Collishaw states that fertility differentials within Canada, though generally declining, are still related to the variables considered by Henripin. The importance of cultural variables has greatly diminished, but education and income (for which the relationship has become positive) are still influential. A monograph on fertility is now in preparation, but the author's findings were not available when the present monograph was written.

In another Canadian study, Balakrishnan, Kantner and Allingham (1975) surveyed women in Toronto in 1968. The survey results clearly show that the relationships observed at the national level are also found within a highly urbanized environment. Associations with fertility are found for religion, wife's labour force status, place of birth, and education, although the relationship for this last

variable is less obvious in Toronto than in Canada as a whole. No systematic association is found between variations in income and variations in fertility.

The same relationships were revealed by a survey on fertility in Quebec (Henripin and Lapierre-Adamcyk, 1974), but here there was marked convergence in the patterns for the various groups.

From the preceding review of the literature, two conclusions can be drawn:

(a) an analysis of variations in fertility according to census tract should be worthwhile; there is reason to believe that a relationship exists between tract characteristics and fertility; and

(b) it must be recognized that a number of individual characteristics are also associated with fertility variations in Canada.

When the unit of observation is small or samples are unavailable, it is hard to measure the importance of each of these individual characteristics with conventional cross-tabulations. Under these circumstances, aggregate data and statistical analysis must be used instead. Data classified by census tract are a valuable source of information on small geographic areas that correspond very closely to the setting in which families carry on their lives, make decisions about having children, and interact with and possibly influence one another. The chance of finding empirical confirmation for the hypothesis of a relationship between environment and fertility should accordingly be greater if the census tract is the unit of observation.

CHAPTER 2

FERTILITY VARIATIONS IN CANADIAN METROPOLITAN AREAS

One of the most important factors in the study of fertility variations is the urban/rural distinction. Almost everywhere in the world, there are marked fertility differentials between urban and rural areas. Canada is no exception, and although Canadian fertility patterns are converging noticeably, the behaviour of urban and rural couples still differs. For all age groups in 1971, for example, fertility in rural areas was approximately 40% greater than in urban areas with more than 100,000 residents. Collishaw, in a profile study entitled Fertility in Canada (1971, pp. 31-32), shows that the larger the population of an urban area, the lower the fertility of the women who live there, whatever their age. This phenomenon is illustrated in Table 2.1. Collishaw also notes that the decline in

TABLE 2.1. Per Cent Deviation in Fertility, Women Ever-married by Selected Age Groups, Urban Size Groups, Rural Non-farm and Rural Farm, Canada, 1971

Region	Age group			
	15 years and over	20-24 years	30-34 years	40-44 years
Number of live births per 1,000 women ever-married	2,775	910	2,621	3,348
Index, all areas	100	100	100	100
Urban areas				
100,000 and over	92	84	88	85
30,000 - 99,999	108	93	99	100
10,000 - 29,999	111	104	102	103
Under 10,000	122	113	108	112
Rural areas				
Non-farm areas	136	137	124	126
Farm areas	150	133	125	129

Source: Statistics Canada, 1971 Census of Canada, Catalogue No. 92-718, Bulletin 1.2-6, Table 24.

Canadian fertility during the 1960s was observed in all urban and rural areas. In addition, the author discusses fertility differentials between the urbanized core and the fringes of metropolitan areas; the fringes have considerably higher fertility rates, which is unsurprising, since the suburbs generally grow to meet increasing family needs.

A final observation to be made is that fertility is lower in the very large metropolitan areas of Canada than in all Canadian urban areas combined. The figures for Montréal, Toronto, and Vancouver, and all urban areas are compared in Table 2.2.

TABLE 2.2. Per Cent Deviation in Fertility of Three Canadian Metropolitan Areas, 1971

Region	15 years and over	Age group		
		20-24 years	30-34 years	40-44 years
Number of live births per 1,000 women ever-married	2,558	832	2,448	3,098
Index, all urban areas	100	100	100	100
Metropolitan areas				
Montréal	96	88	91	94
Toronto	83	92	90	84
Vancouver	86	91	93	89

Source: Statistics Canada, 1971 Census of Canada, Catalogue No. 92-718, Bulletin 1.2-6, Table 26

2.1. Individual Variations in Fertility

As we go from rural to urban areas, we find that fertility rates decline and become more uniform. As previously noted, however, fertility still varies within metropolitan areas, where it is much lower in the urbanized core than in the suburban fringe. A closer look at individual variations in fertility within metropolitan areas quickly reveals that the patterns here are uniform only in relative terms. This is illustrated in Table 2.3, which gives for several geographic areas the coefficients of variation[1] in number of live births, up to the time of the census, per 1,000 women in the age group 25-34.

TABLE 2.3. Variation in Fertility Among Women Aged 25-34, for Canada, Rural Farm Areas, Urban Areas, and the Metropolitan Areas of Montréal, Toronto and Calgary, 1971

Region	Number of live births per 1,000 women ever-married		
	Mean	Standard deviation	Coefficient of variation
			per cent
Canada	2,135	1,557	72.9
Rural farm areas	2,815	2,108	74.9
Urban areas	1,986	1,463	73.7
100,000 and over	1,857	1,293	69.6
Montréal	1,810	1,381	76.3
Toronto	1,779	1,283	72.1
Calgary	1,981	1,431	72.1

Source: Statistics Canada, 1971 Census of Canada, Catalogue No. 92-718, Bulletin 1.2-6, Tables 24 and 26

The coefficients given above show that there is as much relative variation in fertility in the major metropolitan areas of Canada as there is nationwide. It should be noted, however, that these coefficients definitely underestimate deviation from the mean, because all women with six or more children had to be

See footnote(s) on page 34.

considered as one group for purposes of computation. As Table 2.4 shows, in highly urbanized areas there are fewer women with large numbers of children, even though the relative degree of variation approximates that in rural areas and in Canada as a whole.

TABLE 2.4. Percentage of Women Ever-married aged 25-34 Who Have Had Six or More Children, Urban Areas, Rural Farm Areas and Metropolitan Areas of Calgary, Montréal and Toronto, 1971

Region	Per cent
Canada	29.9
Urban areas	19.7
Urban areas pop. 100,000 and over	14.7
Rural farm areas	61.4
Metropolitan areas(1)	
Calgary	16.1
Montréal	14.6
Toronto	11.1

(1) Census tracts with fewer than 300 women ever-married have been excluded. See Appendix C for explanation.

Source: Statistics Canada, 1971 Census of Canada, unpublished data from census summary tapes.

When individual variations in fertility in metropolitan areas are analysed by census tract, these differences too are found to be quite large. For each census tract in Montréal and Toronto, the average number of children born to women aged 25-34 was computed, as well as the standard deviation and the coefficient of variation for this ratio. An average was then computed for each of these measurements for each city. The results are given in Table 2.5.

TABLE 2.4. Percentage of Women Ever-married Aged 25-34 Who Have Had Six or More Children, Urban Areas, Rural Farm Areas and Metropolitan Areas of Calgary, Montréal and Toronto, 1971

Régions	Per cent
Canada	2.99
Urban areas	1.97
Urban areas pop. 100,000 and over	1.47
Rural farm areas	6.14
Metropolitan areas[1]	
Calgary	1.61
Montréal	1.46
Toronto	1.11

(1) Census tracts with fewer than 300 women ever-married have been excluded. See Appendix C for explanation.

Source: Statistics Canada, 1971 Census of Canada, unpublished data from census summary tapes.

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By Evelyne Lapierre-Adamcyk

ERRATA

In Table 2.4, page 22 figures were in error. The attached extract include the corrected figures as they should appear.

TABLE 2.5. Average Number of Children Born for Women Aged 25-34, Standard Deviation, and Coefficient of Variation for Census Tracts[1] in the Metropolitan Areas of Montréal and Toronto, 1971

Metropolitan area	Average number of children born	Average standard deviation	Average coefficient of variation
Montréal	1,832	1,348	76.2
Toronto	1,787	1,298	76.3

(1) See Table 2.4, footnote 1.

Source: Statistics Canada, 1971 Census of Canada, calculations based on data from census tract summary tapes.

As we have seen, fertility ratios in metropolitan areas are low, but far from uniform. There are relatively large individual variations in these areas, and the variations are just as great within individual census tracts. Such differences reflect how widely couples vary in their physiological makeup, their attitudes toward childbearing, and the kind of choices they make.

2.2. Variation in Fertility by Census Tract

Census tracts are:

"small, permanent...statistical areas that have been established in thirty of the large urban communities...The following criteria were used to delineate these areas:

(a) a population between 2,500 and 8,000, except for tracts in the central business district and for institutional tracts;

(b) an area as homogeneous as possible in terms of economic status and living conditions;

(c) boundaries that follow permanent and easily recognizable geographic features; and

(d) a shape as compact as possible.[2]"

Since Statistics Canada tries to place families with similar social and economic characteristics in the same census tract, an analysis of variation in fertility among tracts should be worthwhile, revealing relationships between the socio-economic environment and fertility.

See footnote(s) on page 34.

In the preceding section it was shown that within the census tract there are large variations in individual fertility; in Table 2.6 below, it can be seen that from one tract to another, average fertility also differs considerably. This table gives the average number of children born for women aged 25-34 in census tracts of the seven Canadian metropolitan areas that are considered in this study. Montréal, Toronto, and Vancouver have been chosen because they are the most important urban centres in Canada. Halifax, Ottawa, Winnipeg, and Calgary were selected because they represent the major regions of the country.

TABLE 2.6. Average Fertility for Census Tracts(1) in Seven Canadian Metropolitan Areas, 1971

Metropolitan area	Number of children born as of 1971 per 1,000 women ever-married aged 25-34			
	Mean	Standard deviation	Coefficient of variation	Number of census tracts
			per cent	
Calgary	1961	419	21.4	76
Halifax	2058	545	26.5	39
Montréal	1832	396	21.6	474
Ottawa	1943	365	18.8	109
Toronto	1787	405	22.7	397
Vancouver	1791	464	25.9	159
Winnipeg	1970	401	20.4	95

(1) See Table 2.4, footnote 1.

Source: Statistics Canada, 1971 Census of Canada, calculations based on data from census tract summary tapes.

As the above table shows, the variation in average number of children born up to the time of the census for women in this age group is of the order of 20%. This index, however, is not the most appropriate for establishing relationships between area of residence and fertility. Because urban families are very mobile, such associations are more likely to be found with an index measuring recent births - ones more likely to have occurred in the area under consideration. The ratio of children aged 0-4 to women ever married aged 15-44 is one such measure of current fertility, and the most suitable for a study of census tracts.

This ratio has two shortcomings:

(a) the numerator can be affected by differing rates of infant mortality in different census tracts, though these rates have fallen to very low levels, so they should not have much influence. In Montréal, for example, exogenous infant mortality (that specifically associated with living conditions) fluctuates around five deaths per 1,000 live births;[3] and

(b) the number of children born can also be biassed upward or downward because of the age distribution of women ever married, but tests have shown that the resulting differentials are negligible.

The denominator, on the other hand, should be relatively large, because it includes most women of childbearing age, and sampling error is thereby reduced. Appendix C gives the procedure that was used to determine the minimum number of women needed to make a sufficiently reliable measurement of fertility.

The fertility index just described, which will henceforth be referred to as the child-woman ratio, represents fertility during the five years preceding the census. Variation in this index for the seven metropolitan areas dealt with in this study is shown in Table 2.7.

TABLE 2.7. Variation in the Number of Children Aged 0-4 per 1,000 Women Ever-married Aged 15-44, for Seven Metropolitan Areas of Canada, 1971

Metropolitan area	Average child-woman ratio	Standard deviation	Coefficient of variation	Number of census tracts
			per cent	
Calgary	564	127	22.5	76
Halifax	665	121	18.2	39
Montréal	522	116	22.2	474
Ottawa	584	140	24.0	109
Toronto	520	130	25.0	397
Vancouver	505	128	25.3	159
Winnipeg	592	136	23.0	95

Source: Statistics Canada, 1971 Census, unpublished data from census summary tapes.

See footnote(s) on page 34.

Vancouver is the area in which fertility was lowest during the five years preceding 1971; Halifax is the area with the highest ratio. Fertility was also very low in Montréal and Toronto, where only one out of two married women had a child during the years in question.

The seven areas show about the same amount of variation in fertility, except for Halifax, where fertility ratios are somewhat more uniform from tract to tract.

The coefficients of variation shown here for census tracts are much smaller than those given earlier for individuals: tract fertility variations are of the order of 20% to 25%, compared to individual variations of more than 75%. Although this is a marked decrease, the variation is still large enough to justify an examination of the factors that may be associated with it.

2.3. Selection of Variables to Be Correlated with Fertility

The variables to be correlated with fertility were selected in accordance with what is already known about the relationships between fertility and the socio-economic conditions in which Canadian families live. Certainly the most relevant variables are those used by Henripin (1972) in his monograph on the 1961 census, and by Balakrishnan, Kantner and Allingham (1975) for their survey in Toronto. Henripin's variables are useful because they provide a precise image of Canadian society as a whole, in all its diversity. The variables chosen by Balakrishnan et al. are of interest because they were used to analyse fertility in one of the metropolitan areas dealt with in this study. The two sets of variables are given in Table 2.8.

Most of these factors are closely related to fertility in Canada. It is difficult, however, to determine the specific influence of each. Henripin attempts to do so for some factors by holding others constant. His results are presented in Table 2.9, which is taken from the conclusion of his monograph.

TABLE 2.8. Variables Analysed in Henripin (1972) and Balakrishnan, Kantner and Allingham (1975)

Henripin (1968)	Balakrishnan et al. (1975)
Age of wife	Age of wife
Type of residence	
Duration of marriage	Duration of marriage
Age at marriage	
Country of birth and period of immigration	Country of birth
Ethnic origin	
Mother tongue	
Religion	Religion and church attendance
Husband's occupation	Husband's occupation
Level of schooling	Education
Income	Husband's income
Labour force status of wife	Labour force status of wife

TABLE 2.9. Specific Influence of Certain Factors on Fertility of Women Aged 45-49 in 1961

Factor for which the influence is measured	Other factors whose influence is disregarded	Category in which fertility is lowest	Category in which fertility is highest	Ratio of highest to lowest fertility
Type of residence	Husband's and wife's schooling; husband's income; religion; mother tongue	Metropolitan areas	Rural non-farm(1)	1.40(1)
Schooling of wife	Schooling and income of husband	University graduate	Elementary	1.41
Schooling of husband	Wife's schooling and husband's income	University graduate	Elementary	1.28
Religion of wife	Husband's and wife's schooling; husband's income; mother tongue	Protestant(2)	Catholic(2)	1.32
Income of husband	Husband's and wife's schooling	$3,000-$5,000	Less than $1,000	1.24
Mother tongue of wife	Husband's and wife's schooling; husband's income; religion	English(3)	French(3)	1.06

(1) We were unable to include rural farm environment in view of the absence of information on income; no doubt we would have found the fertility level to be higher in this environment than in the rural non-farm environment and the ratio would then have been higher.

(2) Only the Protestant and Catholic religions were included.

(3) Only the English and French mother tongues were taken into consideration.

Source: J. Henripin, 1968, Trends and Factors of Fertility in Canada, 1961 Census Monograph, Dominion Bureau of Statistics, p. 341.

The preceding table shows that education of each spouse, religion, husband's income and the urban/rural distinction are variables having a specific influence that can be observed when the effects of the other variables are controlled. Mother tongue does not have as strong an influence as it once did. (See Henripin, 1968, pp. 180-186.)

In Balakrishnan et al., the technique used to isolate the influences of the factors is multiple classification analysis. They find that fertility differentials according to education, religion and church attendance, and husband's income are lower but still noticeable when the influences of wife's age and duration of marriage are controlled; differences by country of birth, however, become greater when these two factors are controlled. The most important variable is wife's participation in the labour force, which has a strong negative effect on fertility when the influence of the other variables is controlled. (See Balakrishnan et al., 1975, pp. 180-186.)

In addition to the variables just discussed, certain characteristics of census tracts are correlated with fertility, as has been shown in the previously cited studies by Duncan and Rhodes.

A review of the literature has thus revealed that a range of factors of various types are associated with fertility. Because this study examines relationships between environment and fertility, certain variables reflecting the characteristics of the environment constituted by the census tract will also be considered. These include period of construction of dwellings, type of tenure, and length of occupancy. It should of course be understood that the variables measured for individuals in the earlier studies are calculated here for the census tract as a whole. Brief definitions of the variables included in the present study are given in Table 2.10; the formulas used to calculate them are given in Appendix B.

TABLE 2.10. Variables Used to Analyse Census Tract Fertility for 1971

Number of the variable	Variables
X1	Percentage of Roman Catholics
X2	Percentage of persons of British ethnic origin
X3	Percentage of owner-occupied dwellings
X4	Percentage of dwellings occupied for more than 10 years
X5	Percentage of dwellings built after 1945
X6	Female labour force participation rate
X7	Male occupational index
X8	Percentage of married women among women aged 15-24
X9	Percentage of migrants from outside province
X10	Percentage of migrants within same province
X11	School attendance rate
X12	Percentage of English speakers (English most often spoken at home)
X13	Average income of head of household
X14	Percentage of single persons
X15	Percentage of divorced persons
X16	Percentage of elderly persons
X17	Percentage of persons born outside Canada
X18	Schooling index (population not attending school)
X19	Average rent
X20	Ratio of children aged 0-4 to women ever-married aged 15-44

(1) The following list shows the abbreviation of the variables as used in Table 2.11 and in Chapter 3:

X1 = Percentage of Catholics
X2 = Percentage of British origin
X3 = Percentage of owner-occ. dwell.
X4 = Percentage of dwell. occ. more than 10 years
X5 = Percentage of dwell. built after 1945
X6 = Female participation rate
X7 = Occupational index
X8 = Percentage of married women aged 15-24
X9 = Percentage of interprov. migrants
X10 = Percentage of intraprov. migrants
X11 = School attendance
X12 = Percentage of English speakers
X13 = Average income
X14 = Percentage single
X15 = Percentage divorced
X16 = Percentage of elderly
X17 = Percentage born outside Canada
X18 = Schooling index
X19 = Average rent
X20 = Ratio children/women

The choice of indexes and the methods used to calculate them were partially determined by the availability of data and funds. Because of difficulties in using the census tract summary tapes, it was in some cases necessary to accept a less informative index. For example, the female labour force participation rate covers all women instead of married women aged 15-44, and the school attendance rate covers the entire population instead of women alone. Finally, an index for crowdedness of dwellings had to be omitted, even though preliminary tests of the 1961 census data suggested that it was a particularly good indicator of socio-economic conditions.

Table 2.11 gives the mean and the coefficient of variation for each index for each metropolitan area. The coefficient of variation is a measure of dispersion that is more readily comparable than the standard deviation when means for various areas differ widely from one another.

This table allows us to make several important observations:

(a) in all areas except Montréal and Ottawa, the percentage of English speakers is quite high and shows very little variation;
(b) in Halifax and Calgary, census tracts are homogeneous with respect to the percentage of Catholics and the percentage of persons of British ethnic origin;
(c) in every metropolitan area, school attendance rates and female participation rates are fairly uniform;
(d) in Montréal, the mean percentage of migrants from outside the province is conspicuously lower than elsewhere, and the variation in this index is a great deal higher; and
(e) Montréal is the area with the highest coefficient of variation for nine of the nineteen variables; most striking is the greater variability in the percentage of English speakers, the percentage of British origin, and the percentage of migrants from outside the province (which includes immigrants).

Since we now have a suitable measure of current fertility for census tracts and a set of indexes for the socio-economic, cultural, and "ecological" characteristics of these units, we are now ready to investigate the correlations

Table 2.11. Mean Values and Coefficients of Variation[1] for Socio-economic Indexes X1 to X19 for Seven Metropolitan Areas of Canada, 1971

Variables[2]	Calgary (76 tracts)		Halifax (39 tracts)		Montréal (474 tracts)		Ottawa (109 tracts)	
	Mean	Coefficient of variation	Mean	Coefficient of variation	Mean	Coefficient of variation	Mean	Coefficient of variation
X1: Percentage of Catholics	22.2	19.8	38.1	18.6	78.9	27.4	59.0	42.0
X2: Percentage of British origin	56.0	11.3	77.8	4.0	15.1	109.3	44.5	53.5
X3: Percentage of owner-occ. dwell.	61.3	37.8	44.4	41.7	37.4	68.9	51.7	48.9
X4: Percentage of dwell. occ. more than 10 yrs.	24.0	59.2	27.7	37.2	26.3	39.3	25.0	46.8
X5: Percentage of dwell. cons. after 1945	83.5	25.3	66.7	38.5	66.9	47.2	72.3	38.3
X6: Female participation rate	46.0	15.2	43.6	16.5	37.2	20.2	45.7	14.9
X7: Occupational index	31.6	30.7	23.4	30.8	30.3	33.0	23.8	45.8
X8: Percentage of married women aged 15-24	35.3	37.7	31.7	43.8	26.5	35.1	29.5	39.0
X9: Percentage of interprov. migrants	19.6	40.3	13.6	44.1	6.0	108.0	14.3	51.7
X10: Percentage of intraprov. migrants	8.3	36.1	11.3	43.4	14.9	73.2	12.3	56.9
X11: School attendance	67.0	19.0	71.4	14.7	65.6	13.0	12.0	14.7
X12: Percentage of English speakers	93.9	4.2	97.4	2.3	23.3	106.4	61.8	51.6
X13: Average income	8,779	32.6	8,144	25.1	7,730	39.0	9,000	30.3
X14: Percentage single	25.0	21.2	28.8	25.0	30.1	19.9	29.1	20.6
X15: Percentage divorced	4.1	73.2	2.3	52.2	1.5	86.7	2.0	85.0
X16: Percentage of elderly	8.5	72.9	8.2	51.2	9.3	47.3	8.7	63.2
X17: Percentage born outside Canada	20.5	24.4	7.6	39.5	14.1	92.2	12.7	55.1
X18: Schooling index	30.2	49.7	32.6	57.6	27.2	41.2	30.6	43.1
X19: Average rent	140	23.4	132	17.3	98	30.9	136	25.5

	Toronto (397 tracts)		Vancouver (159 tracts)		Winnipeg (95 tracts)	
X1: Percentage of Catholics	32.3	46.4	17.6	34.1	25.9	51.7
X2: Percentage of British origin	57.1	31.5	59.3	18.5	42.7	34.0
X3: Percentage of owner-occ. dwell.	58.9	38.4	64.4	41.3	63.3	37.1
X4: Percentage of dwell. occ. more than 10 yrs.	28.3	48.1	29.1	40.2	35.0	39.7
X5: Percentage of dwell. cons. after 1945	66.9	50.7	69.5	31.5	58.1	50.3
X6: Female participation rate	48.7	14.6	43.3	19.2	46.1	12.1
X7: Occupational index	33.9	34.5	35.6	34.6	33.1	29.6
X8: Percentage of married women aged 15-24	34.0	37.4	30.5	41.3	30.8	36.4
X9: Percentage of interprov. migrants	14.2	50.7	15.9	39.6	11.2	57.1
X10: Percentage of intraprov. migrants	10.9	98.2	13.9	60.4	8.5	45.9
X11: School attendance	69.0	14.5	67.8	20.2	66.8	14.8
X12: Percentage of English speakers	81.5	19.6	91.7	8.5	86.1	12.4
X13: Average income	8,969	37.5	8,654	35.5	7,688	38.9
X14: Percentage single	25.5	23.5	25.4	22.0	27.0	20.7
X15: Percentage divorced	2.6	76.9	4.5	66.7	2.9	82.8
X16: Percentage elderly	10.1	53.5	12.5	47.2	13.0	44.6
X17: Percentage born outside Canada	34.0	34.7	26.5	30.2	20.3	36.0
X18: Schooling index	26.9	44.6	24.4	48.4	25.3	42.7
X19: Average rent	147	21.1	136	24.3	111	24.3

(1) The coefficient of variation is the ratio between the standard deviation and the mean and is expressed as a percentage.
(2) See Table 2.10 for complete list of variables.

between environment and fertility. The findings for the 1971 Census data will be presented in Chapter 3, and those for the 1961 Census data in Chapter 4. In both chapters, once the results have been presented for each of the metropolitan areas, they will be compared. As we have already noted, the seven areas have fairly similar fertility levels and show about the same amount of variation in fertility. In their socio-cultural and economic characteristics, however, they vary much more widely. It remains to be seen whether this diversity will be reflected in the correlations between these characteristics and fertility. The purpose of this analysis is to uncover constant patterns and persistent associations; it is hoped that once all the correlation coefficients have been calculated and the effects of each variable have been determined, a more coherent picture of the relationships between environment and fertility will emerge.

FOOTNOTES

(1) The coefficient of variation is the ratio between the standard deviation and the mean and is expressed as a percentage.

(2) Statistics Canada, 1971 Census of Canada, Census Tract Bulletin, Series A and B, Introduction.

(3) Quebec Ministry of Social Affairs, La mortalité dans les aires sociales de la région métropolitaine de Montréal, 1976, p. 37.

CHAPTER 3

SOCIO-ECONOMIC CORRELATES OF FERTILITY IN CANADIAN METROPOLITAN AREAS, 1971

This chapter is an analysis of correlates of fertility in seven metropolitan areas of Canada, based on data from the 1971 Census. The analysis will proceed as follows:

(a) the socio-economic variables will be grouped into a small number of clusters; the clusters found in the seven metropolitan areas will be compared; and indicator variables will be selected for the analysis of correlations with fertility;

(b) the correlations of the indicator variables with fertility and the relative importance of each will be determined; and

(c) the results for the seven metropolitan areas will be compared.

3.1. Grouping of Socio-economic Variables

The variables listed in Chapter 2 can be used to represent the characteristics of census tracts, and thereby afford a means of correlating differences in environment with variation fertility. There are, however, technical limitations on the number of variables that can be conveniently analysed simultaneously. Also, to achieve better understanding of the complex relationships among phenomena, we must try to synthesize the information available. For both these reasons, we must try to focus on the most fundamental factors at work in the community.

A technique based on the principles of cluster analysis[1] has therefore been used to group the nineteen independent variables into a number of clusters; the number ranges from two to four, depending on the city. This grouping technique is described in detail in Appendix A, but the two main principles on which it is based should be noted here:

(a) variables that belong to the same cluster should be closely correlated with each other; and

(b) the correlation profiles of variables in the same cluster should be similar; the correlation profile of a variable is the set of its

See footnote(s) on page 60.

coefficients of correlation with each of the other variables. If two variables show a close correlation with each other, they should also display a similar pattern of correlation with the other variables under consideration.

The grouping is carried out in the following manner. A matrix of the correlation coefficients of the variables is constructed, and then a second matrix, for their correlation profiles, is generated from the first. Next, a minimum value is chosen for the coefficient of correlation between two profiles, and pairs of variables whose profiles have correlations exceeding this minimum are identified. If the minimum is set too high (if many variables cannot be placed in any group), a lower one is chosen and the operation is repeated. Should any variables remain ungrouped even after an acceptable minimum has been selected, they will be assigned to the clusters whose Holzinger's B-coefficients will be least affected by this addition. Holzinger's B-coefficient measures the relationship of the sum of the coefficients of correlation between the members of a cluster and the sum of the coefficients of correlation between the members of a cluster and the variables outside it. According to Harman, the B-coefficient must exceed 130 if the variables within a cluster are to be considered more similar to each other than to the outside variables.

Once the grouping is completed, each cluster must still be inspected carefully to determine whether any of the variables added in the last step should be removed and considered separately in the analysis. The grouping algorithm is useful in that it gives the analyst an opportunity to deal with a good many variables for several metropolitan areas and to place them in some preliminary order. It does not, however, preclude the necessity of critically examining the results and exercising judgment in the selection of variables for a cluster.

We will now consider the clusters of socio-economic variables derived from the 1971 Census data. Table 3.1 shows, for each cluster in each metropolitan area, the constituent variables, the range of the coefficients of correlation between each variable and the others in the cluster, the average value of these coefficients for each variable, the coefficient of correlation of each variable with the child-woman ratio, the B-coefficient, and the name of the indicator variable chosen to represent the cluster for the next step in the analysis.

TABLE 3.1. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan Areas, 1971

Metropolitan area and variables[1]	Range of intracluster correlation coefficients (absolute values)	Average of coefficients of correlation	Coefficient of correlation with child-woman ratio	Selected variable
Halifax				
Cluster 1 (B-coefficient: 251)				
Percentage of Catholics	.272 - .584	.465	.338	
School attendance(2)	.272 - .637	.442	-.298	Average income
Average income	.584 - .714	.645	-.496	
Average rent	.418 - .714	.557	-.484	
Cluster 2 (B-coefficient: 178)				
Percentage British origin	.031 - .759	.503	-.334	
Percentage owner-occ. dwell.	.107 - .514	.352	-.151	
Female participation rate	.031 - .736	.511	-.047	Schooling
Percentage married women 15-24[2]	.031 - .239	.114	-.008	index
Percentage English speakers	.149 - .759	.520	-.417	
Percentage divorced	.239 - .675	.556	-.280	
Schooling index	.127 - .736	.433	-.484	
Cluster 3 (B-coefficient: 379)				
Percentage dwell. occ. more than 10 yrs.	.652 - .838	.745	-.246	Percentage of
Percentage of interprov. migrants	.587 - .838	.713	-.396	interprov.
Percentage of intraprov. migrants.	.585 - .652	.620	-.072	migrants
Cluster 4 (B-coefficient: 483)				
Percentage dwell. cons. after 1945	.750 - .906	.828	-.552	Percentage of
Percentage single	.750 - .775	.763	-.335	dwell. cons.
Percentage of elderly	.775 - .906	.840	-.369	after 1945
Cluster 5 (B-coefficient: 394)				
Occupational index	.629	.629	.271	Occupational
Percentage born outside Canada			-.182	index
Calgary				
Cluster 1 (B-coefficient: 298)				
Percentage of Catholics	.451 - .612	.531	.313	Percentage
Percentage of British origin	.612 - .674	.643	-.427	of
Occupational index	.451 - .674	.563	.406	British origin
Cluster 2 (B-coefficient: 2367)				
Percentage of owner-occ. dwell.	.430 - .834	.630	.258	
Percentage of dwell built after 1945	.036 - .817	.526	.063	
Female participation rate	.122 - .694	.389	-.558	
Percentage of interprov. migrants[2]	.036 - .430	.164	-.037	
School attendance	.303 - .834	.607	.240	Percentage
Percentage single	.082 - .759	.525	-.632	single
Percentage divorced	.141 - .768	.622	-.291	
Percentage of elderly	.104 - .841	.576	-.234	
Percentage born outside Canada	.043 - .841	.510	-.081	
Schooling index	.028 - .793	.602	.380	
Average rent	.293 - .610	.492	-.040	
Cluster 3 (B-coefficient: 697)				
Percentage of dwell. occ. more than 10 yrs.	.680	.680	-.155	Percentage of
Percentage of intraprov. migrants			.109	dwell. occ. more than 10 yrs.
Cluster 4 (B-coefficient: 267)				
Percentage of married women 15-24	.392 - .696	.544	.315	Percentage of
Percentage of English speakers	.392 - .511	.452	-.197	married women
Average income	.511 - .696	.604	-.208	15-24

See footnote(s) at end of table.

TABLE 3.1. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan Areas, 1971 - continued

Metropolitan area and variables[1]	Range of intracluster correlation coefficients (absolute values)	Average of coefficients of correlation	Coefficient of correlation with child-woman ratio	Selected variable
Montréal				
Cluster 1 (B-coefficient: 371)				
Percentage of Catholics	.056 - .891	.568	.081	
Percentage of British origin	.083 - .887	.481	-.038	
Percentage of dwell. occ. more than 10 yrs.[2]	.006 - .512	.182	.108	
Occupational index	.034 - .734	.504	.353	
Percentage of married women 15-24[2]	.070 - .512	.266	.182	Occupational index
Percentage of interprov. migrants	.246 - .827	.463	-.025	
Percentage of English speakers	.006 - .891	.560	-.082	
Average income	.021 - .849	.446	-.154	
Percentage born outside Canada	.105 - .827	.379	-.073	
Average rent	.261 - .849	.542	-.212	
Cluster 2 (B-coefficient: 492)				
Percentage of owner-occ. dwell.	.666	.666	.189	Percentage of owner-occ. dwell.
School attendance			.068	
Cluster 3 (B-coefficient: 320)				
Percentage of dwell. built after 1945	.493 - .595	.544	-.013	
Percentage of intraprov. migrants	.493 - .535	.516	.257	Percentage single
Percentage single	.519 - .544	.535	-.412	
Percentage of elderly	.535 - .595	.557	-.292	
Cluster 4 (B-coefficient: 350)				
Female participation rate	.610 - .687	.649	-.446	Schooling index
Percentage divorced	.610 - .619	.615	-.429	
Schooling index	.619 - .687	.653	.468	
Ottawa				
Cluster 1 (B-coefficient: 365)				
Percentage of Catholics	.057 - .984	.644	-.119	
Percentage of British origin	.095 - .988	.647	.114	
Female participation rate[2]	.054 - .500	.337	-.304	
Occupational index	.312 - .765	.580	.136	Occupational index
Percentage of intraprov. migrants[2]	.002 - .312	.151	.167	
Percentage of English speakers	.139 - .988	.656	.087	
Average income	.002 - .769	.459	.134	
Percentage born outside Canada	.274 - .784	.566	-.006	
Average rent	.132 - .769	.579	.032	
Cluster 2 (B-coefficient: 236)				
Percentage of owner-occ. dwell.	.524 - .689	.601	.362	
Percentage of married women 15-24	.114 - .678	.348	-.029	
School attendance	.350 - .689	.523	.289	Percentage of owner-occ. dwell.
Percentage single	.206 - .667	.474	-.484	
Percentage divorced	.220 - .671	.527	-.353	
Schooling index	.114 - .667	.487	.272	
Cluster 3 (B-coefficient: 351)				
Percentage of dwell. occ. more than 10 yrs.	.656	.656	.090	Percentage of dwell. occ. more than 10 yrs.
Percentage of interprov. migrants				
Cluster 4 (B-coefficient: 439)				
Percentage of dwell. built after 1945	.787	.787	.138	Percentage of elderly
Percentage of elderly			-.236	

See footnote(s) at end of table.

TABLE 3.1. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan Areas, 1971 - continued

Metropolitan area and variables[1]	Range of intracluster correlation coefficients (absolute values)	Average of coefficients of correlation	Coefficient of correlation with child-woman ratio	Selected variable
Toronto				
Cluster 1 (B-coefficient: 412)				
Percentage of Catholics	.351 - .857	.553	.273	
Percentage of British origin	.209 - .887	.510	-.131	
Percentage of dwell. built after 1945	.162 - .559	.350	-.141	
Occupational index	.022 - .654	.402	.425	
Percentage of married women 15-24	.044 - .496	.302	.200	Occupational index
Percentage of interprov. migrants	.064 - .714	.390	.058	
Percentage of English speakers	.267 - .913	.610	-.251	
Average income	.306 - .628	.444	-.278	
Percentage born outside Canada	.265 - .913	.571	.046	
Average rent	.064 - .660	.353	-.387	
Cluster 2 (B-coefficient: 265)				
Percentage of owner-occ. dwell.	.476 - .689	.578	.173	
Percentage of dwell. occ. more than 10 yrs.	.134 - .476	.235	-.073	
Female participation rate	.240 - .603	.459	-.431	Female participation rate
School attendance	.179 - .665	.517	.123	
Percentage divorced	.134 - .689	.485	-.300	
Schooling index	.146 - .612	.483	.423	
Cluster 3 (B-coefficient: 192)				
Percentage of intraprov. migrants[2]	.380 - .404	.392	.140	
Percentage single	.400 - .404	.402	-.372	Percentage single
Percentage of elderly	.380 - .400	.390	-.121	
Vancouver				
Cluster 1 (B-coefficient: 329)				
Percentage of Catholics	.457 - .673	.549	.082	
Percentage of British origin	.596 - .843	.686	-.246	Percentage of British origin
Percentage of English speakers	.451 - .843	.589	-.132	
Average income	.451 - .680	.549	.013	
Average rent	.457 - .680	.558	-.235	
Cluster 2 (B-coefficient: 613)				
Percentage of owner-occ. dwell.	.489 - .866	.665	.584	
Percentage of dwell. occ. more than 10 yrs.	.022 - .718	.376	.286	
Female participation rate	.152 - .760	.548	.633	
Percentage of married women 15-24	.033 - .582	.312	.033	
Percentage of interprov. migrants	.159 - .718	.514	.369	Schooling index
School attendance	.381 - .812	.590	.553	
Percentage single	.078 - .701	.444	.566	
Percentage divorced	.336 - .866	.645	.601	
Percentage of elderly	.022 - .669	.341	.353	
Percentage born outside Canada	.033 - .656	.434	.309	
Schooling index	.208 - .792	.577	.649	
Cluster 3 (B-coefficient: 109)				
Percentage of dwell. built after 1945	.044 - .527	.286	-.044	Percentage of intraprov. migrants
Occupational index(2)	.044 - .250	.147	.465	
Percentage of intraprov. migrants	.250 - .527	.389	.305	Occupational index

See footnote(s) at end of table.

TABLE 3.1. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan Areas, 1971 - concluded

Metropolitan area and variables(1)	Range of intracluster correlation coefficients (absolute values)	Average of coefficients of correlation	Coefficient of correlation with child-woman ratio	Selected variable
Winnipeg				
Cluster 1 (B-coefficient: 279)				
Percentage of Catholics	.344 - .817	.511	.242	
Percentage of British origin	.494 - .783	.607	-.182	
Occupational index	.344 - .659	.541	.305	Occupational index
Percentage of English speakers	.523 - .817	.663	-.287	
Average rent	.370 - .659	.513	-.215	
Cluster 2 (B-coefficient: 1383)				
Percentage of owner-occ. dwell.	.457 - .851	.625	.108	
Percentage of dwell. built after 1945	.115 - .794	.475	-.261	
Female participation rate	.156 - .604	.381	-.262	
Percentage of married women 15-24(2)	.063 - .559	.231	.131	
School attendance	.443 - .851	.606	.192	Schooling index
Percentage single	.122 - .762	.552	-.201	
Percentage divorced	.203 - .795	.579	-.128	
Percentage of elderly	.161 - .794	.524	-.036	
Percentage born outside Canada	.171 - .688	.484	.101	
Schooling index	.093 - .714	.570	.255	
Cluster 3 (B-coefficient: 137)				
Percentage of dwell. occ. more than 10 yrs.	.095 - .725	.488	.024	Percentage of dwell. occ. more than 10 yrs.
Percentage of interprov. migrants	.129 - .725	.407	.014	
Percentage of intraprov. migrants	.011 - .644	.341	-.018	
Average income(2)	.011 - .129	.078	-.203	Average income

(1) See Table 2.10 for complete list of variables.
(2) These variables had correlation profiles noticeably different from those of all the others and were added to the clusters whose B-coefficients were least diminished by this addition.

The indicator variables selected were in principle those that showed the highest coefficient of correlation with the child-woman ratio. In some cases, however, the variable that met this criterion had a low average coefficient of correlation with the others in its group, which suggested that it was not the best representative of the cluster. When this problem arose, another variable was selected that had a slightly lower coefficient of correlation with fertility but was more representative of the cluster.

At first glance, it would seem that the clusters are quite diverse, each metropolitan area displaying a distinctive pattern of relationships among the socio-economic variables. Upon closer examination, however, certain similarities emerge:

(a) in all areas except Halifax and Calgary, the variables percentage of Catholics, percentage of persons of British ethnic origin, percentage of English speakers, and average rent belong to the same cluster; except in Vancouver, the male occupational index also falls in this cluster; average income of head of household belongs to this group as well, except in Winnipeg; and

(b) in several areas, the percentage of owner-occupied dwellings, the female labour force participation rate, the school attendance rate, the percentage of single persons, the percentage of divorced persons, and the schooling index occur in the same cluster; although this set of variables is not found in its entirety in as many areas as the first set, it does occur with some variations in all the areas.

These two groupings are especially meaningful, because the coefficients of correlation within them are for the most part relatively high. The process for grouping variables is based primarily on the similarity of their correlation profiles, and such similarity may be found even among variables that are not strongly correlated with each other. It is therefore reassuring to see that the variables constituting each of these two groups are in general closely interrelated.

For the remaining variables, no regular pattern can be seen; they are associated either with one another or with the two groups described above. Those variables assigned according to the B-coefficient criterion, however, show much lower correlations, and it will be worthwhile to analyse their relationship to fertility

separately.

The signs of the coefficients of correlation within each of the two groups are the same in every metropolitan area. In the first group, the percentage of Catholics is negatively related to the percentage of persons of British origin and to the percentage of English speakers; it is also negatively related to average income of head of household, and average rent. But is is positively related to the male occupational index, which is negatively correlated with all the other variables. A clear picture thus emerges: a higher percentage of Catholics goes with a lower proportion of English speakers and persons of British origin, a lower average income and rent, and a higher proportion of manual workers. This strong and regular relationship between certain cultural (ethnic and linguistic) characteristics and certain economic indexes is worth noting.

For the second group, the results show that the greater the proportion of owner-occupied dwellings, the lower the proportion of single persons, divorced persons, and women who are members of the labour force. The inverse association of home ownership with single and divorced persons presumably arises because owner-occupied dwellings tend to be single-family houses; census tracts where they are most numerous would have little attraction for single persons and persons living alone, who prefer apartments. The negative relationship between the proportion of owner-occupied dwellings and the female participation rate is not surprising. This rate was calculated for all women in each tract, and differences in the labour-force status of married women are probably the primary element in its variation. Since the census tracts where owner-occupied homes are more common are located in the suburbs, where women raising families are found, they are also likely to be the tracts with lower female participation rates.

Apart from their similarity as regards these two groups of variables, the metropolitan areas present an extremely diverse picture. Choosing indicator variables to represent the clusters in the analysis of fertility variations is also complicated, because the same selection criterion cannot be applied in all cases. As already mentioned, sometimes the variable that has the highest coefficient of correlation with the child-woman ratio is not very representative of its group. Because the methodological orientation of this study is primarily empirical, the numerical values were used as selection criteria as much as possible. In some

cases, however, variables have been selected on theoretical grounds in hopes of discovering more consistent patterns in the correlations for the various metropolitan areas.

3.2. Correlations of Indicator Variables with Fertility

As described in the preceding section, the 19 socio-economic variables under consideration were grouped into clusters of variables closely related to each other; the grouping technique is such that the variables within a cluster can be said to be more strongly correlated with each other than with variables outside the cluster. For the analysis of correlates of fertility, each cluster is represented by an indicator variable. The variable selected for this purpose is the one that has the highest coefficient of correlation with the fertility index.

Only four indicator variables have been used for each metropolitan area, because it has been found that the addition of new variables to a multiple regression equation already containing three of four usually produces only a very small increase in the proportion of variation explained. The main purpose of this study is not to account for as much variation as possible, but to determine which factors contribute the most to the statistical explanation of differences in fertility. Although the number of variables to be analysed is limited, each represents a group of closely interrelated indexes, so the risk of excluding any factors really pertinent to fertility variations is reduced.

We will now consider the degree of correlation of the indicator variables with the child-woman ratio. Table 3.2 shows, for each metropolitan area, the names of the indicator variables and their coefficients of simple, partial, and multiple correlation with this ratio.

A first observation we can make is that the simple correlation coefficients are in general not very high, the highest, .649, is found in Vancouver, for the schooling index. The lowest, .024, is for the percentage of homes occupied for more than 10 years in Winnipeg.

The partial correlation coefficients are generally lower: when three of four variables are held constant, the relationship between the fourth and the child-woman ratio becomes weaker. There are some exceptions to this rule, however. In Calgary, the simple coefficient already shows a substantial negative relation-

TABLE 3.2. Coefficients of Correlation Between Selected Socio-economic Variables and the Child-woman Ratio, for Seven Canadian Metropolitan Areas, 1971

Metropolitan area and variables[1]	Simple correlation coefficient (r)	Partial correlation coefficient ($r_{ij.klm}$)	Multiple correlation coefficient
Calgary			
Percentage of British origin	-.427	-.412	R = .752
Percentage single	-.633	-.659	
Percentage dwell. occ. more than 10 years	-.155	-.013	R^2 = .566
Percentage of married women aged 15-24	.315	.213	
Halifax			
Average income	-.496	-.336	R = .637
Schooling index[2]	-.202	.023	
Percentage interprov. migrants	-.396	-.054	R^2 = .405
Percentage dwell. built after 1945	-.552	-.361	
Montréal			
Occupational index	.353	.142	R = .563
Percentage owner-occ. dwell.	.189	-.170	
Percentage single	-.412	-.263	R^2 = .317
Schooling index(2)	.468	.286	
Ottawa			
Occupational index	.136	.067	R = .392
Percentage owner-occ. dwell.	.362	.231	
Percentage dwell. occ. more than 10 years	.090	.061	R^2 = .154
Percentage of elderly	-.236	-.125	
Toronto			
Occupational index	.425	.363	R = .666
Female participation rate	-.431	-.492	
Percentage single	-.372	-.243	R^2 = .444
Percentage of interprov. migrants	.058	.377	
Vancouver			
Percentage of British origin	-.246	-.200	R = .699
Schooling index(2)	.649	.562	
Percentage interprov. migrants	.305	.168	R^2 = .490
Occupational index	.465	.032	
Winnipeg			
Occupational index	.305	.128	R = .416
Schooling index(2)	.255	.292	
Percentage dwell. occ. more than 10 years	.024	.024	R^2 = .173
Average income	-.203	-.120	

(1) See Table 2.10 for complete list of variables.
(2) The schooling index increases in value with the proportion of less educated people in the population. See Appendix B.

ship between the percentage of single persons and the child-woman ratio; when the three other factors are held constant, this relationship grows slightly stronger. In Toronto, there are two exceptions, one of them quite spectacular. The effect of the female labour force participation rate is increased somewhat by the partial correlation, but the percentage of migrants from outside the province jumps from a simple coefficient of almost nil to a partial coefficient of .377. Finally, in Winnipeg, the schooling index also increases when the other variables are held constant. There are no cases in which a high simple correlation coefficient is replaced by a partial coefficient of the opposite sign.

The multiple correlation coefficient measures the combined effect of all four variables. It is highest in Calgary and lowest in Ottawa. Only in Calgary do we see more than 50% of the variation in fertility explained. In Ottawa and Winnipeg, less than 20% is explained.

3.3. Relative Importance of the Indicator Variables

The square of the multiple correlation coefficient, as has just been seen, tells us what proportion of the variation in fertility is explained by the four factors considered. This proportion is the starting point for the next stage of the analysis, in which a technique developed by Newton and Spurrel will be used to partition the explained variation into its several components: the independent contributions of each factor and their various joint contributions.

Newton and Spurrell use their technique to clarify the problem of interpreting regression coefficients in cases where the variables assumed to be independent are actually interdependent. They show that the contribution made by a variable when added to a set of other variables equals b_i^2/c_{ii}, where b_i is the regression coefficient and c_{ii} is the i^{th} member of the diagonal of the inverse matrix of sums of squares and products of the variables in the regression. The value b_i^2/c_{ii} is the independent contribution of a variable--that which it makes over and above what it contributes jointly with the other variables. A value can be estimated for the independent contribution of each variable in the equation and for the joint contributions made by all possible combinations of the variables. Each independent contribution is positive by definition, whereas the joint contributions may be negative. A negative joint contribution means that the effect of the association of two variables is to reduce the influence that one of them has on the dependent

variable. The independent and joint contributions are all calculated using a series of equations in which the terms are partial and multiple correlation coefficients (see Appendix D).

It must be stressed that the estimates of independent and joint contributions will hold only for the set of variables that originally appear in the equation. If a new variable is introduced, the independent contribution of each original variable will be changed at least by the amount of its joint contribution with the new variable.

Table 3.3 shows the relative importance of the contributions of each of the indicator variables in each metropolitan area. We will now review the results for each area in detail.

In Calgary, the four indicator variables are the percentage of persons of British ethnic origin, the percentage of single persons, the percentage of dwellings occupied for more than 10 years, and the percentage of married women among women aged 15-24. These factors explain 56.6% of the variance in the child-woman ratio. As we have already seen from the partial correlation coefficients, three of the four factors in Calgary have a weaker effect when the others are held constant. The effect of the percentage of single persons, however, is greater when the other variables are controlled.

Analysis of the squared multiple correlation coefficient shows that this last variable makes the most important contribution of the four: 59% of explained variation. The percentage of dwellings occupied for more than 10 years has almost no effect on the fertility ratio, and the effect of the percentage of women married is also very small. The percentage of persons of British origin is the only other variable of much influence; it accounts for 15.7% of explained variation. The variables for tenure of dwellings and marital status of women could be eliminated with only a 3.7% loss of statistical explanation. Another indication that the marital status variable does not add appreciably to explained variation is that its independent contribution is lower in absolute value than its joint contribution with the ethnic variable (.05655). This means that the effect of the percentage of married women among women aged 15-24 is exerted indirectly, through the percentage of persons of British origin. When the percentage of women married is excluded from the model and the other three variables are retained, the independent contribution of the percentage of persons of British origin jumps to 26.6%.

Table 3.3 Independent and Joint Contributions of Selected Socio-economic Variables to the Statistical Explanation of Variation in Fertility in Seven Canadian Metropolitan Areas, 1971

Dependent variable: 1. Child/woman ratio

Metropolitan area and variables[1]	Independent contribution	Metropolitan area and variables[1]	Independent contribution
Calgary		Halifax	
2. Percentage of British origin	.08866	2. Average income	.07557
3. Percentage single	.33327	3. Schooling index	.00032
4. Percentage of dwell. occ. more than 10 years	.00007	4. Percentage interprov. migrants	.00171
5. Percentage of married women aged 15-24	.02066	5. Percentage of dwell. built after 1945	.08920
	Joint contributions		Joint contributions
2 & 4	.00107	2 & 4	.01411
2 & 3	.01192	2 & 3	.00529
2 & 5	.05655	2 & 5	.06058
4 & 5	.00002	4 & 5	.02764
4 & 3	.02269	4 & 3	.00018
3 & 5	.01252	3 & 5	.03081
3,4 & 5	-.00558	3,4 & 5	.01001
2,3 & 4	.00929	2,3 & 4	.00385
2,4 & 5	-.00113	2,4 & 5	.09586
2,3 & 5	.01848	2,3 & 5	.01321
2,3,4 & 5	-.00233	2,3,4 & 5	.00353
Total (R^2)	.56617	Total (R^2)	.40545
	Independent contribution		Independent contribution
Montréal		Ottawa	
2. Occupational index	.01397	2. Occupational index	.00377
3. Percentage of owner-occ. dwell.	.02043	3. Percentage of owner-occ. dwell.	.04778
4. Percentage single	.05087	4. Percentage of dwell. occ. more than 10 years	.00321
5. Schooling index	.06092	5. Schooling index	.01336
	Joint contributions		Joint contribution
2 & 4	.00486	2 & 4	.00485
2 & 3	.03052	2 & 3	-.00236
2 & 5	.07086	2 & 5	.00522
4 & 5	.03193	4 & 5	-.00274
4 & 3	-.01336	4 & 3	.03126
3 & 5	-.01998	3 & 5	.07194
3,4 & 5	.06185	3,4 & 5	-.02961
2,3 & 4	-.00924	2,3 & 4	.00931
2,4 & 5	.04814	2,4 & 5	-.00522
2,3 & 5	-.02938	2,3 & 5	.00583
2,3,4 & 5	-.00519	2,3,4 & 5	-.00296
Total (R^2)	.31721	Total (R^2)	.15365

See footnote(s) at end of table.

Table 3.3 Independent and Joint Contributions of Selected Socio-economic Variables to the Statistical Explanation of Variation in Fertility in Seven Canadian Metropolitan Areas, 1971 - concluded

Dependent variable: 1. Child/woman ratio

Metropolitan area and variables (1)	Independent contribution	Metropolitan area and variables (1)	Independent contribution
Toronto		Vancouver	
2. Occupational index	.08426	2. Percentage of British origin	.02122
3. Female participation	.17773	3. Schooling index	.23531
4. Percentage single	.03489	4. Percentage of interprov. migrants	.01485
5. Percentage of interprov. migrants	.09182	5. Occupational index	.00052
	Joint contributions		Joint contributions
2 & 4	.05314	2 & 4	-.01028
2 & 3	.00613	2 & 3	-.02078
2 & 5	.02867	2 & 5	.03836
4 & 5	-.02082	4 & 5	.00519
4 & 3	.04892	4 & 3	.01836
3 & 5	-.06932	3 & 5	.06701
3,4 & 5	.00067	3,4 & 5	.08775
2,3 & 4	.03574	2,3 & 4	.01504
2,4 & 5	-.01390	2,4 & 5	-.00108
2,3 & 5	-.01329	2,3 & 5	.05494
2,3,4 & 5	-.00048	2,3,4 & 5	-.03690
Total (R^2)	.44418	Total (R^2)	.48950
	Independent contribution		
Winnipeg			
2. Occupational index	.01375		
3. Schooling index	.07692		
4. Percentage of dwell. occ. more than 10 years	.00049		
5. Average income	.01214		
	Joint contributions		
2 & 4	.00371		
2 & 3	.04142		
2 & 5	.07664		
4 & 5	-.00048		
4 & 3	.00263		
3 & 5	-.01170		
3,4 & 5	.00026		
2,3 & 4	-.00681		
2,4 & 5	.00197		
2,3 & 5	-.03635		
2,3,4 & 5	-.00118		
Total (R^2)	.17341		

(1) See Table 2.10 for complete list of variables.

The most important variable for Calgary, the percentage of single persons, stands for a very large cluster of variables reflecting the housing characteristics and the degree of social homogeneity of the census tract. The relationship between the percentage of single persons and fertility is negative, which means that the more the housing available in a census tract appeals to single persons, elderly persons, and persons living alone, the lower the tract fertility will be, because families will prefer larger, single-family homes. This relationship probably arises because couples who have children or wish to have them decide to live in neighbourhoods especially suitable for raising families.

In Halifax, the variables that have been correlated with fertility are average income of head of household, the schooling index, the percentage of migrants from outside the province, and the percentage of dwellings constructed after 1945. Here the percentage of variation explained is approximately 40.5. The variable making the greatest independent contribution is the percentage of dwellings constructed after 1945, which is negatively correlated with fertility. It may be assumed that this inverse relationship arises because many more recently built homes are apartments and therefore unattractive to young families. The strong association between the percentage of post-war dwellings and the percentages of single and elderly persons supports this hypothesis.

The second most important variable in Halifax is average income of head of household, which is also negatively correlated with fertility (as many other authors have found). In Halifax we also note one joint contribution (that of income, percentage of post-war dwellings, and percentage of migrants from outside the province) that is greater than any of the independent contributions. Its value is .09586, and it accounts for 23.6% of the explained variation. The size of this joint contribution and of the independent contributions of the income and housing variables shows unequivocally that these two factors provide most of the explanation of differences in fertility. The square of the multiple correlation coefficient for these two variables alone equals 99.5% of R^2 for all four independent variables. When the two equations with three independent variables are worked out, one excluding the housing variable and the other the income variable, the equation that includes the percentage of dwellings built after 1945 provides the greater explanation of variance, confirming the greater importance of this variable.

Turning to Montréal, we find that the indicator variables are the male occupational index, the percentage of owner-occupied dwellings, the percentage of single persons, and the schooling index. Here 32% of the fertility variation is explained. The large joint contributions in Montréal indicate that despite the grouping process the selected variables are closely interrelated. The two most important variables are the schooling index and the percentage of single persons, which together account for 80% of the explained variation. But the two other factors, the occupational index and the home-ownership variable, make contributions that are not negligible. The latter provides more of their combined explanatory power, as can be clearly seen by adding each one separately to the first two variables. Of the four indicators, the schooling index, which represents a cluster containing the female labour force participation rate and the percentage of divorced persons, has the highest correlation with fertility. The occupational index, which shows about the same degree of simple correlation as the other variables, loses all importance in the multiple correlation; its effect on fertility is overshadowed by that of the variables representing the social homogeneity of the census tract and its housing characteristics. In Montréal, variations in fertility are no longer associated with variations in cultural indexes.

In Ottawa, the variables representing the clusters are the male occupational index, the percentage of owner-occupied dwellings, the percentage of dwellings occupied for more than 10 years, and the percentage of elderly persons. These variables explain only 15.4% of the variation in the child-woman ratio. The only important independent contribution is made by the percentage of owner-occupied dwellings, which accounts for 31.1% of the squared multiple correlation coefficient. The joint contribution of this home-ownership variable and the percentage of elderly persons provides almost half of the explanation of variation — 46.8%. The joint contribution of the home-ownership variable and the percentage of dwellings occupied for more than ten years represents another 20.3%. Two independent contributions are quite small: the occupational index independently provides only 2.5% of the statistical explanation and the percentage of dwellings occupied for more than 10 years only 2.1%. Together the home-ownership variable and the percentage of elderly persons account for 92.3% of explained variation. What we must remember, however, is that the four variables combined are unable to explain much of the variation in fertility, and that the factors making any contribution worth noting are those representing the housing characteristics of the census tract.

In Toronto, 44% of the variation in the child-woman ratio is associated with the four indicator variables: the male occupational index, the female labour force participation rate, the percentage of single persons, and the percentage of migrants from outside the province. Unlike the variables in Montréal and Ottawa, whose independent contributions are small compared to their joint contributions, the variables in Toronto make independent contributions representing 87.5% of the explained variation. The percentage of single persons, however, adds little explanation; its effect is manifested through its association with the female participation rate. This rate is the most important variable; it alone accounts for 40% of the explained variation. The second most important variable is the percentage of migrants from outside the province. Its simple correlation with fertility is negligible, but its partial correlation, with the effect of the female participation rate controlled, is higher (.325). The female participation rate is the predominant factor, however, since the partial correlation coefficient for the "migrants" variable with the two other variables controlled is only about .17. Third in order of importance is the male occupational index, contributing 19.0% of the explained variation. As we can see, in Toronto the influence of economic variables — the male occupational index and the female labour force participation rate — is especially pronounced. But the positive correlation between fertility and the percentage of migrants from outside the province is also of interest; it probably means that this independent variable characterizes neighbourhoods attractive to mobile families. A combination of diverse factors is thus associated with fertility variations in this metropolitan area.

In Vancouver, the indicator variables are the percentage of persons of British ethnic origin, the schooling index, the percentage of intraprovincial migrants, and the male occupational index. A relatively large proportion of the variation in fertility (48.9%) is explained by these four factors. There is only one large independent contribution: the schooling index accounts for 48% of the explained variation and 86.5% of the total independent contributions. The joint contributions show that the effect of the three other variables is exerted through the schooling index; their total independent contributions represent only 14% of the explained variation. The schooling index in Vancouver stands for a cluster of variables reflecting the social homogeneity of the census tract and its housing characteristics. Cultural factors thus have only limited importance in this metropolitan area.

In Winnipeg, the indicator variables explain only 17.3% of the variation in fertility. These variables are the occupational index, the schooling index, the percentage of dwellings occupied for more than 10 years, and the average income of head of household. As in Vancouver, the schooling index is the most important factor. The other factors influence fertility through their association with the schooling index.

3.4. Comparison of 1971 Results for the Seven Metropolitan Areas

Table 3.4 shows, for each metropolitan area, the four indicator variables ranked according to their independent contributions to the correlation with fertility. As we know, the indicator variables for each area represent a small number of clusters, each intended to comprise variables with high intercorrelations. The more effective the grouping process has been, the more the indicator variables will contribute independently, rather than jointly, to the total explanation of fertility variations. If there were no relationship between variables in different clusters, the joint contributions would be nil. The results, however, show that even though the variables in each cluster are more closely correlated with each other than with the other variables, the relationships between clusters are still strong. The joint contributions represent more than 50% of the explained variation in Halifax, Montréal, and Ottawa, and between 40% and 45% in Winnipeg and Vancouver; in Toronto, the figure is only 12%. These percentages could probably be slightly reduced by selecting indicator variables according to some other criterion. The results of such a change are reported in Section 3.5. The new criterion was that the indicator variable should be the one with the highest average coefficient of correlation with the other members of its cluster. It must be recognized, however, that relationships among clusters reflect real connections among social phenomena, associations that the analyst cannot ignore.

Returning to the first set of results, we can note that two distinct groups of variables were found in most of the seven metropolitan areas. In the first group, cultural variables are linked with economic variables; in the second, an educational variable is associated with variables reflecting the degree of social homogeneity of the census tract or its housing characteristics. In all of the metropolitan areas save Toronto, one or two indicator variables provide most of the explanation of variation. The indicator for the cluster of cultural and economic variables rarely makes a large contribution; it is first in relative importance

TABLE 3.4. Order of Importance of Selected Socio-economic Variables in Seven Canadian Metropolitan Areas, 1971

Metropolitan area and variables (1)	Independent contribution		Joint contributions
	Independent contribution	Order of importance	
	per cent		per cent
Calgary			
Percentage single	15.7	2	
Percentage of British origin	58.9	1	21.8
Percentage of married women aged 15-24	0.0	4	
Percentage of dwell. occ. more than 10 yrs.	3.6	3	
Halifax			
Average income	18.6	2	
Schooling index	0.1	4	58.9
Percentage of interprov. migrants	0.4	3	
Percentage of dwell. built after 1945	22.0	1	
Montréal			
Occupational index	4.4	4	
Percentage of owner-occ. dwell.	6.4	3	54.0
Percentage single	16.0	2	
Schooling index	19.2	1	
Ottawa			
Occupational index	2.5	3	
Percentage of owner-occ. dwell.	31.1	1	55.6
Percentage of dwell. occ. more than 10 yrs.	2.1	4	
Percentage of elderly	8.7	2	
Toronto			
Occupational index	19.0	3	
Pemale participation rate	40.0	1	12.4
Percentage single	7.9	4	
Percentage of interprov. migrants	20.7	2	
Vancouver			
Percentage of British origin	4.3	2	
Schooling index	48.1	1	44.5
Percentage of intraprov. migrants	3.0	3	
Occupational index	0.1	4	
Winnipeg			
Occupational index	7.9	2	
Schooling index	44.4	1	40.4
Percentage of dwell. occ. more than 10 yrs.	0.3	4	
Average income	7.0	3	

(1) See Table 2.10 for complete list of variables.

only in Calgary, where the percentage of persons of British origin independently contributes 58.9% of the statistical explanation. In all the other cities, the variable for the cultural-economic cluster is either the occupational index or average income, and it makes a very weak contribution, amounting in four cases to less than 10% of explained variation. The most important variable in almost all the metropolitan areas is the schooling index, the female participation rate, or the percentage of owner-occupied dwellings — variables reflecting housing characteristics and social composition of the neighbourhood.

It has thus been seen that cultural and economic variables do not make the most important independent contributions to the explanation of fertility variations in metropolitan areas. The variables closely associated with indicators of attractiveness to families seem more revealing. The large joint contributions, however, indicate that the cultural and economic factors have real effects that cannot be discounted. All the factors come into play, but the predominant influence is exerted by the neighbourhood environment, which may have varying degrees of attraction for families on the one hand and people without children on the other.

3.5. Results with Indicator Variables Selected According to Degree of Intracluster Correlation

In the analysis discussed in the preceding section, each cluster of variables was represented by the member that had the highest coefficient of correlation with the child-woman ratio. This selection criterion increases the percentage of total fertility variation that will be explained by the socio-economic variables. However, if all these variables are closely correlated with fertility, there is a strong likelihood that they will also be fairly closely correlated with each other. The grouping technique is designed so that the members of a cluster will be more highly correlated with each other than with variables outside the cluster, but intercluster correlations do exist, and some of them are substantial. The relatively large joint contributions of the socio-economic indexes (Table 3.4) illustrate that many of them are inextricably linked.

In order to bring out the individual contributions of the various socio-economic indexes to the explanation of fertility variations, a second analysis was carried out. As previously described, this time the indicator variable for each cluster was the one with the highest average coefficient of correlation with the other members of the cluster. These average intracluster correlation coefficients

are shown in Table 3.1. The new indicator variables can be expected to have a lower coefficient of multiple correlation with fertility than the indicators in the preceding analysis, but their independent contributions should represent a greater proportion of the total variation explained.

Let us examine the results given in Table 3.5. For five of the seven cities, the percentage of variation explained (R^2) is lower than in Table 3.2. Winnipeg and Vancouver are the exceptions. In these two cities, the partial correlation coefficients are substantially higher than the simple ones. Among the seven metropolitan areas, the value of R^2 ranges from .15 to .56. Thus the new criterion for selecting the indicators has only slightly reduced the percentage of variation explained. It should therefore be worthwhile to examine the independent and joint contributions to these new values of R^2.

The chief change resulting from the new selection criterion is the increased relative importance of the independent contributions. Ottawa is an exception; but in this city indicators selected according to either criterion account for only a very small percentage of the variation in fertility. Elsewhere, the joint contributions now represent substantially smaller percentages of total variation explained — less than 20% of R^2 in almost all the metropolitan areas. The independent contributions are therefore of greater interest if we wish to learn which socio-economic factors have a strong influence on fertility. We will consider only those indicators whose independent contributions equal 30% or more of R^2. These are:

Percentage of owner-occupied dwellings (Calgary)
Average income of head of household (Halifax)
Schooling index (Montréal)
Percentage of English speakers (Toronto)
Percentage of single persons (Toronto)
Percentage of owner-occupied dwellings (Vancouver)
Percentage of English speakers (Winnipeg)
Percentage of owner-occupied dwellings (Winnipeg)

When we recall which variables are represented by the ones listed above, it becomes evident that one or two dimensions of community life can account for most of the joint effects that these cultural, economic, and "ecological" (housing-related) factors have on fertility. In almost all the metropolitan areas, an important role

TABLE 3.5. Results of Applying the Newton and Spurrell Technique When the Criterion of Selection is: the Highest Average of the Coefficient of Correlation

Metropolitan area and variables (1)	Simple correlation coefficient (r)	Partial correlation coefficient ($r_{ij.klm}$)	Multiple correlation coefficient	Independent contribution	Joint contributions
				pourcentage	
Calgary					
Percentage of British origin	-.427	-.245	R = .617	10.4	
Percentage owner-occ. dwell.	.258	.472		46.8	2.8
Percentage dwell. occ. more than 10 years	-.155	-.297	R^2 = .380	15.8	
Average income	-.208	-.360		24.2	
Halifax					
Average income					
Percentage divorced	-.496	-.470		57.4	
Percentage dwell. occ. more than 10 years	.280	.013	R = .574	0.0	35.9
Percentage of elderly	.246	.008		0.0	
	.369	.179	R^2 = .333	6.7	
Montréal					
Percentage of Catholics	.081	-.125	R = .510	4.5	
Percentage of owner-occ. dwell.	.189	-.224		15.0	15.4
Percentage single	-.292	.020	R^2 = .260	0.1	
Schooling index	.468	.431		65.0	
Ottawa					
Percentage of English speakers	.087	.054	R = .390	1.6	
Percentage owner-occ. dwell.	.362	.190		20.8	57.0
Percentage dwell. occ. more than 10 years	.090	.110	R^2 = .152	6.8	
Percentage of elderly	-.236	-.155		13.8	
Toronto					
Percentage of English speakers	-.251	-.402	R = .527	49.9	
Percentage owner-occ. dwell.	.176	.019		0.1	
Percentage single	-.372	-.359	R^2 = .278	38.4	3.1
Percentage of intraprov. migrants	.140	.178		8.5	
Vancouver					
Percentage of British origin	-.246	-.359	R = .749	11.6	
Percentage of owner-occ. dwell.	.584	.641		54.7	
Percentage of intraprov. migrants	.305	.420	R^2 = .561	16.8	16.8
Occupational index	.465	-.042		0.1	
Winnipeg					
Percentage of English speakers	-.289	-.330	R = .460	45.5	
Percentage of owner-occ. dwell.	.108	.369		58.6	
Percentage dwell. occ. more than 10 years	.024	-.195	R^2 = .212	14.6	-40.0
Average income	-.203	-.233		21.3	

(1) See Table 2.10 for complete list of variables.

is played by variables reflecting the type of housing in the census tract, either the percentage of owner-occupied dwellings or the percentage of single persons. These variables reflect the attractiveness of the census area to young families. Then there are some cities, including Toronto, Vancouver, and Winnipeg, where cultural variables together with economic variables (such as average income and average rent) still have a great influence on fertility. Somewhat surprisingly, this relationship does not hold in Montréal, where the most important variable is the schooling index, a member of a different cluster.

The correlations observed with the new set of indicator variables are not very different from those described in the preceding section. Differences in fertility seem to be associated principally with differences in the types of housing available in various parts of each city. This suggests that the environment has no direct determining influence on fertility; rather, certain types of neighbourhood are more suitable than others for growing young families. We should note, however, that some effect is still exerted by factors reflecting the economic status of the neighbourhood.

As can be seen, the results for the seven metropolitan areas are quite diverse. The strictly empirical criteria used to select the indicator variables prevent us from discovering similarities in the patterns of correlation in the various cities. It therefore becomes difficult to draw any definite conclusions from the data.

In an attempt to discover some uniform pattern among the seven metropolitan areas, a third analysis was carried out using the same four indicator variables for each. The criterion this time was somewhat arbitrary; the indicators chosen were those used most frequently in the two previous analyses. These are the male occupational index, the percentage of owner-occupied dwellings, the percentage of dwellings occupied for more than 10 years, and the percentage of elderly persons. The results of this third analysis are given in Table 3.6. In general, the four variables explain a slightly higher percentage of variation in fertility than in the previous analyses. Many of the independent contributions are fairly large. The occupational index, representing a cluster of cultural and economic variables, comes first in order of importance in almost every metropolitan area. But once again a second factor also makes a contribution that is not negligible.

TABLE 3.6. Results of Applying the Newton and Spurrell Technique When the Criterion of Selection Aims to Standardize the Choice of the Factors from One City to Another

Metropolitan area and variables[1]	Simple correlation coefficient (r)	Partial correlation coefficient ($r_{ij.klm}$)	Multiple correlation coefficient	Independent contribution	Joint contributions
				per cent	
Calgary					
Occupational index	.406	.553	R = .608	75.1	
Percentage of owner-occ. dwell.	.258	.297		16.5	-16.7
Percentage of dwell. occ. more than 10 yrs.	-.158	-.357	R^2 = .369	25.0	
Percentage of elderly	-.234	.028		0.1	
Halifax					
Occupational index	.271	.416	R = .545	49.5	
Percentage of owner-occ. dwell.	-.151	-.120		3.5	9.2
Percentage of dwell. occ. more than 10 yrs.	.246	-.111	R^2 = .297	3.0	
Percentage of elderly	.369	.358		34.8	
Montréal					
Occupational index	.353	.335	R = .438	53.5	
Percentage of owner-occ. dwell.	.189	-.120		13.8	28.2
Percentage of dwell. occ. more than 10 yrs.	-.107	-.111	R^2 = .192	4.0	
Percentage of elderly	-.292	.358		0.5	
Ottawa					
Occupational index	.136	.067	R = .392	2.5	
Percentage of owner-occ. dwell.	.362	.231		31.1	55.6
Percentage of dwell. occ. more than 10 yrs.	.090	.061	R^2 = .154	2.1	
Percentage of elderly	-.236	-.125		8.7	
Toronto					
Occupational index	.425	.463	R = .514	76.0	
Percentage of owner-occ. dwell.	.176	.257		19.7	-36.2
Percentage of dwell. occ. more than 10 yrs.	-.073	-.311	R^2 = .265	30.0	
Percentage of elderly	-.121	.190		10.5	
Vancouver					
Occupational index	.465	.437	R = .692	25.7	
Percentage of owner-occ. dwell.	.584	.479		32.4	36.9
Percentage of dwell. occ. more than 10 yrs.	.286	-.204	R^2 = .478	4.8	
Percentage of elderly	-.353	.037		0.2	
Winnipeg					
Occupational index	.305	.357	R = .375	89.1	
Percentage of owner-occ. dwell.	.108	.202		26.0	-38.7
Percentage of dwell. occ. more than 10 yrs.	.024	-.168	R^2 = .141	17.8	
Percentage of elderly	-.036	.097		5.8	

(1) See Table 2.10 for complete list of variables.

The kinds of relationships revealed by the three analyses discussed so far make it obvious that we are dealing with a very difficult subject. The results for the seven metropolitan areas are so tenuous and diverse — some concordant, some contradictory — that the goal of this study, to identify correlations common to several areas, begins to seem rather unrealistic. One definite pattern does emerge however; the numerous factors we have associated with fertility can be reduced to two dimensions of a community, one its cultural and economic characteristics, the other its housing characteristics and social environment.

In what way do such characteristics influence fertility? Our third analysis may provide some clearer answers to this question, since the indicator variables used in it were the same for each city. From this analysis, we see that the male occupational index, which increases with the proportion of manual workers in the census tract, is positively correlated with fertility; there may thus be an association with fertility at the census-tract level corresponding to that observed at the individual level. The second indicator variable, the percentage of owner-occupied dwellings, is also positively related to fertility, probably because owner-occupied homes tend to be single-family homes, and neighbourhoods with many such homes are very likely to have high fertility ratios. In contrast, the percentage of dwellings occupied for more than 10 years is inversely associated with fertility. This relationship is also unsurprising: couples who have been living in the same home for more than 10 years are likely to have completed their families, so on the whole their current fertility will be low. The fourth indicator variable, the percentage of single persons, is so weakly correlated with fertility that it cannot even be said whether the association is positive or negative.

The joint effects of the variables on fertility are often negative. In such cases, one variable is, offsetting, the influence of another. The male occupational index and the percentage of owner-occupied dwellings is such a pair. Although both have a positive effect on fertility, they are negatively related to each other. The underlying phenomenon in this case may be that the scarcity of one-family homes in working-class neighbourhoods leads their residents to have fewer children.

In the following chapter, we will discuss the correlations calculated from the 1961 data and see what they reveal.

FOOTNOTE

(1) The technique used here is adapted from one developed by Leroy O. Stone and described by him in Migration in Canada: Regional Aspects, 1961 Census Monograph, Dominion Bureau of Statistics, 1969, Appendix D, pp. 353-359.

CHAPTER 4

SOCIO-ECONOMIC CORRELATES OF FERTILITY IN CANADIAN METROPOLITAN AREAS, 1961

In this chapter, we will again analyse correlations between socio-economic factors and fertility, but the data will be taken from the 1961 census rather than the 1971 census. The procedure followed will be the same. It will be interesting to see whether the great diversity of the correlations for 1971 was a repetition of the 1961 situation, or rather the result of changes that took place in fertility patterns during the 1960s.

For this analysis, some changes have had to be made in the group of socio-economic variables, and the most important differences between the 1961 variables and the 1971 variables should be noted before we proceed. First, the school attendance rate for 1961 is for women only, whereas for 1971 it covered both sexes. The language variable for 1961 is the percentage of persons for whom English is the mother tongue, rather than the percentage for whom English is the language spoken most often at home. The formula for the male occupational index is also different, because occupations were classified differently in the two censuses. Finally, the 1961 variables include the percentage of crowded dwellings in the census tract; this is a very revealing socio-economic index that unfortunately could not be calculated for 1971. The complete list of variables for 1961 is given in Table 4.1; the formulas for these variables appear in Appendix B.

4.1. Grouping of Variables and Selection of Indicator Variables

The grouping technique described in the preceding chapter was also used for the 1961 variables, and the results are shown in Table 4.2. As can readily be seen, there is one cluster of variables that appears in all the metropolitan areas except Halifax; it comprises the percentage of Catholics, the percentage of persons of British origin, the male occupational index, the percentage of persons with English as mother tongue, average income of head of household, average rent, and the percentage of crowded dwellings. Thus we see that the cultural and economic characteristics of the census tract are closely interrelated. In five of the areas (Montréal, Toronto, Winnipeg, Calgary, and Vancouver), the schooling index also belongs to this cluster. In Montréal, Ottawa, and Toronto, the percentage of

TABLE 4.1. Socio-economic Variables Used to Analyse 1961 Census Data

Number of the variable	Variables
X 1	Percentage of Roman Catholics
X 2	Percentage of persons of British ethnic origin
X 3	Percentage of owner-occupied dwellings
X 4	Percentage of dwellings occupied for more than 10 years
X 5	Percentage of dwellings constructed after 1945
X 6	Female labour force participation rate
X 7	Male occupational index
X 8	Percentage of married women among women age 15-24
X 9	Percentage of migrants from outside province
X10	Percentage of migrants within same province (intraprovincial migrants)
X11	School attendance rate of women
X12	Percentage of persons with English as mother tongue
X13	Average income of head of household
X14	Percentage of single persons
X15	Percentage of divorced persons
X16	Percentage of elderly persons
X17	Percentage of persons born outside Canada
X18	Female schooling index
X19	Average rent
X20	Percentage of crowded dwellings

(1) The following list shows the abbreviation of the variables as used in Chapter 4:

X 1 = Percentage of Catholics
X 2 = Percentage of British origin
X 3 = Percentage of owner-occ. dwell.
X 4 = Percentage of dwell. occ. more than 10 years
X 5 = Percentage of dwell. built after 1945
X 6 = Female participation rate
X 7 = Occupational index
X 8 = Percentage of married women aged 15-24
X 9 = Percentage of interprov. migrants
X10 = Percentage of intraprov. migrants
X11 = School attendance
X12 = Percentage of English mother tongue
X13 = Average income
X14 = Percentage single
X15 = Percentage divorced
X16 = Percentage of elderly
X17 = Percentage born outside Canada
X18 = Schooling index
X19 = Average rent
X20 = Percentage of crowded dwell.

TABLE 4.2. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan Areas, 1961

Metropolitan area and variables[1]	Range of intracluster correlation coefficients (absolute values)	Average intracluster correlation coefficient	Coefficient of correlation with child-woman ratio	Indicator variable
Calgary[2]				
Cluster 1 (B-coefficient: 263)				
Percentage of Catholics	.385 - .813	.532	.184	
Percentage of British origin	.562 - .874	.741	-.338	
Occupational index	.434 - .929	.742	.279	Occupational index
Percentage of English mother tongue	.671 - .874	.750	.087	
Average income	.562 - .909	.674	.271	
Schooling index	.439 - .929	.768	.217	
Average rent	.425 - .909	.736	.010	
Cluster 2 (B-coefficient: 181)				
Percentage of owner-occ. dwell.	.442 - .924	.670	.737	
Percentage of dwell. occ. more than 10 years	.319 - .874	.547	-.641	Female participation rate
Percentage dwell. built after 1945	.574 - .948	.716	.674	
Female participation rate	.319 - .824	.555	-.750	
Percentage of interprov. migrants	.370 - .874	.548	.505	Percentage of interprov. migrants
Percentage of intraprov. migrants	.356 - .773	.592	.714	
School attendance	.320 - .792	.556	.469	
Percentage single	.585 - .924	.711	-.781	
Percentage divorced	.409 - .910	.660	-.647	
Percentage of elderly	.607 - .948	.718	-.812	
Percentage born outside Canada	.605 - .910	.707	-.651	
Cluster 3 (B-coefficient: 164)				
Percentage of crowded dwell.	.594	.594	.627	Percentage of married women
Percentage of married women aged 15-24			.749	
Halifax				
Cluster 1 (B-coefficient: 121)				
Percentage of Catholics[3]	.273 - .532	.383	-.052	
Percentage of British origin	.243 - .634	.407	-.558	Percentage of British origin
Percentage of intraprov. migrants[3]	.028 - .273	.181	-.218	
Average income	.028 - .634	.398	-.517	
Cluster 2 (B-coefficient: 370)				
Occupational index	.505 - .793	.686	.630	
Percentage born outside Canada	.505 - .794	.637	-.553	Schooling index
Schooling index	.793 - .889	.836	.697	
Average rent	.594 - .867	.758	-.820	
Percentage of crowed dwell.	.654 - .830	.754	.784	
Cluster 3 (B-coefficient: 442)				
Percentage of owner-occ. dwell.	.456 - .802	.687	-.037	
Percentage of dwell. built after 1945	.633 - .815	.714	.331	
Female participation rate	.582 - .891	.745	-.499	
Percentage of interprov. migrants	.380 - .815	.591	.292	Female participation rate
School attendance	.554 - .875	.711	.170	
Percentage of English mother tongue	.380 - .775	.642	.130	
Percentage single	.584 - .811	.729	-.196	
Percentage divorced	.625 - .875	.783	-.322	
Cluster 4 (B-coefficient: 344)				
Percentage of dwell. occ. more than 10 years	.573 - .730	.652	-.609	Percentage of married women aged 15-24
Percentage of married women aged 15-24	.573 - .775	.674	.621	
Percentage of elderly	.730 - .775	.753	-.580	

See footnote(s) at end of table.

TABLE 4.2. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan Areas, 1961 - continued

Metropolitan area and variables[1]	Range of intracluster correlation coefficients (absolute values)	Average intracluster correlation coefficient	Coefficient of correlation with child-woman ratio	Indicator variable
Montréal				
Cluster 1 (B-coefficient: 553)				
Percentage of Catholics	.240 - .890	.607	.421	
Percentage of British ethnic origin	.060 - .955	.509	-.263	
Female participation rate(3)	.060 - .694	.264	-.477	
Occupational index	.184 - .937	.605	.478	Occupational index
Percentage of intraprov. migrants[3]	.038 - .254	.185	.250	
Percentage of English mother tongue	.098 - .955	.577	-.321	
Average income	.038 - .745	.407	-.188	
Percentage divorced	.097 - .694	.333	-.463	Female participation rate
Percentage born outside Canada	.141 - .726	.410	.452	
Schooling index	.123 - .937	.618	.432	
Average rent	.109 - .928	.585	-.447	
Percentage of crowed dwell.	.249 - .748	.464	.433	
Cluster 3 (B-coefficient: 200)				
Percentage of owner-occ. dwell.	.263 - .634	.494	.204	
Percentage of dwell. occ. more than 10 years	.094 - .685	.350	-.008	Percentage of interprov. migrants
Percentage of dwell. built after 1945	.288 - .685	.547	.083	
Percentage of interprov. migrants	.351 - .624	.499	.251	
School attendance	.094 - .575	.343	-.025	
Percentage single	.309 - .605	.438	-.242	
Cluster 3 (B-coefficient: 286)				
Percentage of married women aged 15-24	.542	.542	.206	Percentage of elderly
Percentage of elderly			-.356	
Ottawa				
Cluster 1 (B-coefficient: 466)				
Percentage of Catholics	.631 - .986	.850	.581	
Percentage of British ethnic origin	.573 - .992	.816	.603	
Occupational index	.506 - .882	.729	.620	
Percentage of English mother tongue	.561 - .992	.812	-.571	Occupational index
Average income	.308 - .697	.569	-.378	
Percentage born outside Canada	.308 - .768	.631	-.628	
Average rent	.633 - .881	.792	-.660	
Percentage of crowded dwell.	.529 - .831	.748	.699	
Cluster 2 (B-coefficient: 215)				
Percentage of owner-occ. dwell.	.109 - .700	.447	.137	
Percentage of dwell. occ. more than 10 years	.292 - .823	.552	-.309	Percentage of dwell. built after 1945
Percentage of dwell. built after 1945	.207 - .823	.652	.324	
Female participation rate	.169 - .699	.496	-.581	
Percentage of married women aged 15-24[3]	.109 - .484	.315	.482	
Percentage of interprov. migrants	.270 - .817	.557	.162	Percentage of married women aged 15-24
Percentage of interaprov. migrants	.265 - .707	.483	.091	
School attendance	.332 - .645	.449	-.110	
Percentage single	.484 - .772	.629	-.381	
Percentage of elderly	.340 - .826	.584	-.587	
Cluster 3 (B-coefficient: 225)				
Percentage divorced	.517	.517	-.558	Schooling index
Schooling index			.763	

See footnote(s) at end of table.

TABLE 4.2. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan Areas, 1961 - continued

Metropolitan area and variables[1]	Range of intracluster correlation coefficients (absolute values)	Average intracluster correlation coefficients	Coefficient of correlation with child-woman ratio	Indicator variable
Toronto				
Cluster 1 (B-coefficient: 636)				
Percentage of Catholics	.400 - .838	.733	.102	
Percentage of British origin	.234 - .918	.610	.032	
Occupational index	.462 - .924	.754	.323	
Percentage of married women aged 15-24[3]	.026 - .633	.399	.292	
Percentage of English mother tongue	.309 - .938	.711	.042	Occupational index
Average income	.400 - .805	.691	-.149	
Percentage born outside Canada	.252 - .938	.615	-.227	
Schooling index	.503 - .924	.757	-.335	
Average rent	.234 - .718	.590	-.461	
Percentage of crowded dwell.	.448 - .758	.696	.325	
Cluster 2 (B-coefficient: 324)				
Percentage of owner-occ. dwell.	.575 - .616	.595	.170	Female participation rate
Female participation rate	.616 - .826	.721	.473	
School attendance	.575 - .826	.701	.332	
Cluster 3 (B-coefficient: 356)				
Percentage of dwell. occ. more than 10 years	.631 - .732	.690	-.282	Percentage of interprov. migrants
Percentage of dwell. built after 1945	.569 - .732	.660	.180	
Percentage of interprov. migrants	.569 - .666	.622	.586	
Percentage of elderly	.666 - .709	.685	-.390	
Cluster 4 (B-coefficient: 168)				
Percentage of intraprov. migrants[3]	.129 - .251	.190	.211	Percentage single
Percentage single	.251 - .829	.540	-.426	
Percentage divorced	.129 - .829	.479	-.444	
Vancouver				
Cluster 1 (B-coefficient: 1006)				
Percentage of Catholics	.287 - .677	.484	.090	
Percentage of British origin	.419 - .773	.632	-.396	
Occupational index	.399 - .889	.651	.454	
Percentage of married women aged 15-24	.245 - .594	.442	.319	Occupational index
Percentage of English mother tongue	.245 - .773	.488	-.029	
Average income	.434 - .776	.560	-.084	
Schooling index	.527 - .889	.682	.388	
Average rent	.419 - .742	.596	-.273	
Percentage of crowded dwell.	.350 - .675	.524	.477	
Cluster 2 (B-coefficient: 389)				
Percentage of owner-occ. dwell.	.295 - .839	.588	.470	
Percentage of dwell. occ. more than 10 years	.048 - .613	.212	-.023	Percentage dwell. occ. more than 10 years
Percentage of dwell. built after 1945	.403 - .692	.529	.257	
Female participation rate	.048 - .733	.483	-.774	
Percentage single	.075 - .802	.557	-.401	
Percentage divorced	.443 - .839	.595	-.559	Female participation rate
Percentage of elderly	.130 - .728	.464	-.369	
Percentage born outside Canada	.127 - .728	.576	-.293	
Cluster 3 (B-coefficient: 470)				
Percentage of interprov. migrants	.699 - .906	.803	-.256	Percentage of interprov. migrants
Percentage of intraprov. migrants	.656 - .906	.781	-.266	
School attendance	.656 - .699	.678	-.105	

See footnote(s) at end of table.

TABLE 4.2. Results of Applying the Grouping Technique to Variables Representing Socio-economic Indices for Seven Canadian Metropolitan areas, 1961 - concluded

Metropolitan area and variables (1)	Range of intracluster correlation coefficients (absolute values)	Average intracluster correlation coefficient	Coefficient of correlation with child-woman ratio	Indicator variable
Winnipeg				
Cluster 1 (B-coefficient: 561)				
Percentage of Catholics	.237 - .707	.441	.269	
Percentage of British origin	.438 - .949	.593	-.291	
Occupational index	.417 - .850	.676	.387	Occupational index
Percentage of married women aged 15-24	.094 - .660	.448	.370	
Percentage of interprov. migrants	.109 - .628	.411	.243	
Percentage of English as mother tongue	.422 - .949	.619	-.189	Percentage of interprov. migrants
Average income	.344 - .719	.565	-.082	
Schooling index	.391 - .850	.625	.327	
Average rent	.498 - .815	.633	-.263	
Percentage of crowded dwell.	.109 - .611	.445	.500	
Cluster 2 (B-coefficient: 330)				
Percentage of owner-occ. dwell.	.096 - .879	.614	.299	
Percentage of dwell. occ. more than 10 years (3)	.027 - .431	.188	.243	Percentage dwell. occ. more than 10 years
Percentage of dwell. built after 1945	.171 - .744	.505	.327	
Female participation rate	.027 - .880	.576	-.459	
Percentage of intraprov. migrants	.048 - .638	.334	-.047	
School attendance	.086 - .880	.574	.263	Female participation rate
Percentage single	.092 - .812	.580	-.401	
Percentage divorced	.079 - .879	.574	-.343	
Percentage of elderly	.128 - .744	.521	-.455	
Percentage born outside Canada	.048 - .609	.427	-.222	

(1) See Table 4.1 for complete list of variables.

(2) For the Calgary data, when the grouping process was carried to completion using the minimum correlation coefficient originally selected as the grouping criterion, eighteen of the twenty independent variables fell in the same cluster, because they are so strongly interrelated. A higher minimum was therefore used to achieve the final grouping.

(3) See Tableau 3.1, footnote (2).

persons born outside Canada is in this cluster as well.

The directions of covariation within this cluster are the same in all the metropolitan areas, and the overall pattern may be described as follows: a higher percentage of Catholics in a given neighbourhood goes with a lower proportion of persons of British origin or with English as their mother tongue, a lower economic status and lower cost of housing, a higher percentage of crowded dwellings, a lower average income and education, and a predominantly working-class population.

The male occupational index will be used to represent this cluster in the analysis of correlations with fertility. There are two reasons for this decision in almost all of the cities, this variable has the highest average correlation with the other members of this cluster; in addition, it is strongly associated with fertility. Selecting this variable does of course reduce the variety of the factors that will be considered in the analysis.

Since no consistent pattern can be readily detected in the other clusters, the variables representing them will be selected so as to achieve the best compromise among three criteria. Ideally, each indicator should have a high correlation with fertility, be the most representative of its cluster, and be used for several metropolitan areas. The process of selection quickly reveals two variables, the female labour force participation rate and the percentage of migrants from outside the province, that are representative of groups appearing in almost all the metropolitan areas.

4.2. Correlations of Indicator Variables with Fertility

Table 4.3 shows the coefficients of correlation between the indicator variables and the child-woman ratio. The partial correlations are usually weaker than the simple correlations, but there are several exceptions to this rule. The most important ones will simply be mentioned here (we shall return to them in Section 4.3):

(a) in Calgary, for three of the four indicators, the partial correlation with fertility is much stronger than the simple correlation; however, for the percentage of married women among women aged 15-24, and holding the other variables constant results in a substantially

TABLE 4.3. Coefficients of Correlation between Selected Socio-economic Variables and the Child-woman Ratio, for Seven Canadian Metropolitan Areas, 1961

Metropolitan area and variables (1)	Simple correlation coefficient (r)	Partial correlation coefficient ($r_{ij.klm}$)	Multiple correlation coefficient
Calgary			
Occupational index	.279	.744	R = .967
Percentage of married women aged 15-24	.749	.295	
Female participation rate	-.750	.883	R^2 = .936
Percentage of interprov. migrants	.505	.747	
Halifax			
Schooling index	.697	.264	R = .835
Female participation rate	-.499	-.329	
Percentage of married women aged 15-24	.621	.272	R^2 = .696
Percentage of British origin	-.558	-.477	
Montréal			
Occupational index	.478	.436	R = .631
Female participation rate	-.477	-.235	
Percentage of interprov. migrants	.244	.236	R^2 = .398
Percentage of elderly	-.356	.038	
Ottawa			
Percentage of dwell. built after 1945	.324	.289	R = .846
Occupational index	.620	.461	
Schooling index	.764	.370	R^2 = .716
Percentage of married women aged 15-24	.482	.165	
Toronto			
Female participation rate	-.473	-.486	R = .763
Occupational index	.329	.552	
Percentage of interprov. migrants	.586	.552	R^2 = 582
Percentage single	-.426	.290	
Vancouver			
Occupational index	.454	.406	R = .839
Female participation rate	-.774	-.778	
Percentage of interprov. migrants	-.256	-.298	R^2 = .704
Percentage of dwell. occ. more than 10 years	-.023	-.187	
Winnipeg			
Occupational index	.387	.637	R = .749
Percentage of interprov. migrants	.243	.304	
Female participation rate	-.459	-.489	R^2 = .561
Percentage dwell. occ. more than 10 years	-.225	-.175	

(1) See Table 4.1 for complete list of variables.

weaker link with fertility; and

(b) in Toronto and Winnipeg, controlling the other variables strengthens the relationship between the occupational index and fertility.

In all the metropolitan areas except Montréal, the four variables together explain more than 50% of the variation in fertility--several of the multiple correlation coefficients are strikingly high. In the next section we will analyse these coefficients to identify their most important components.

4.3. Relative Importance of the Indicator Variables

In Table 4.4, the multiple correlation coefficients for each metropolitan area are partitioned so that the relative importance of each indicator variable can be observed.

In Calgary, the combination of the male occupational index, the female labour force participation rate, the percentage of migrants from outside the province, and the percentage of married women among women aged 15-24 explains 94% of the variation in fertility. The female participation rate is first in order of importance, followed by the percentage of migrants from outside the province and the occupational index. However, the independent contributions amount to less than half of the explained variation (42.3%), while the joint contributions are rather sizable. For example, the entire effect of the variable "percentage of married women" is transmitted through the other three. Its joint contributions with the occupational index and the percentage of migrants from outside the province are .22784 and .18430 respectively, but its joint contribution with the female participation rate and the migration variable is .28267, accounting for the greatest part of its influence.

The existence of many large joint contributions indicates that the variables are closely interrelated. In this type of analysis, when two variables have independent contributions smaller than their joint contribution, it is often advisable to eliminate one of them from the equation. In general, little statistical explanation will be lost in the process. In the present case, all the variables except the percentage of married women will still make large independent contributions after such an elimination, despite the close associations among the

TABLE 4.4. Independent and Joint Contributions of Selected Socio-economic Variables to the Statistical Explanation of Variation in Fertility in Seven Canadian Metropolitan Areas, 1961

Dependent variable: 1. Child-woman ratio

Metropolitan area and variables[1]	Independent contributions	Metropolitan area and variables[1]	Independent contributions
Calgary		Halifax	
2. Occupational index	.07972	2. Schooling index	.02276
3. Percentage of married women aged 15-24	.00613	3. Female participation rate	.03685
4. Female participation rate	.22833	4. Percentage married women aged 15-24	.02429
5. Percentage of interprov. migrants	.08148	5. Percentage of British origin	.08951
	Joint contributions		Joint contributions
2 & 4	.00787	2 & 4	.01782
2 & 3	.22784	2 & 3	.01023
2 & 5	-.07252	2 & 5	.19445
4 & 5	.06337	4 & 5	.00244
4 & 2	.11570	4 & 3	.12577
3 & 5	.18430	3 & 5	-.02610
3,4 & 5	.28267	3,4 & 5	-.04194
2,3 & 4	.11930	2,3 & 4	.14728
2,4 & 5	-.01392	2,4 & 5	.09571
2,3 & 5	-.13317	2,3 & 5	-.01658
2,3,4 & 5	-.13738	2,3,4 & 5	.01389
Total (R^2)	.93559	Total (R^2)	.69639
	Independent contributions		Independent contributions
Montréal		Ottawa	
2. Occupational index	.14163	2. Percentage dwell. built after 1945	.02592
3. Female participation rate	.03534	3. Occupational index	.07655
4. Percentage of interprov. migrants	.03536	4. Schooling index	.04518
5. Percentage of elderly	.00087	5. Percentage married women aged 15-24	.00789
	Joint contributions		Joint contributions
2 & 5	-.03498	2 & 4	.19557
2 & 3	.08194	2 & 3	-.02232
2 & 5	.02748	2 & 5	.01587
4 & 5	.00277	4 & 5	-.00413
4 & 3	.06326	4 & 3	.30967
3 & 5	-.00064	3 & 5	.04585
3,4 & 5	.03191	3,4 & 5	.12981
2,3 & 4	-.05152	2,3 & 4	-.14656
2,4 & 5	-.00258	2,4 & 5	.04540
2,3 & 5	.05171	2,3 & 5	-.01707
2,3,4 & 5	.01521	2,3,4 & 5	.00819
Total (R^2)	.39776	Total (R^2)	.71593

See footnote(s) at end of table.

TABLE 4.4. Independent and Joint Contributions of Selected Socio-economic Variables to the Statistical Explanation of Variation in Fertility in Seven Canadian Metropolitan Areas, 1961 - concluded

Dependent variable: 1. Child-woman ratio

Metropolitan area and variables (1)	Independent contributions
Toronto	
2. Female participation rate	.12924
3. Occupational index	.18311
4. Percentage of interprov. migrants	.18302
5. Percentage single	.03834
	Joint contributions
2 & 4	.03255
2 & 3	-.09121
2 & 5	-.03636
4 & 6	-.03634
4 & 3	-.03126
3 & 5	-.03833
3,4 & 5	.05976
2,3 & 4	-.00471
2,4 & 5	.16363
2,3 & 5	.05385
2,3,4 & 5	-.02328
Total (R^2)	.58199

Metropolitan area and variables (1)	Independent contributions
Vancouver	
2. Occupational index	.05834
3. Female participation rate	.45426
4. Percentage of interprov. migrants	.02882
5. Percentage dwell. occ. more than 10 yrs.	.01071
	Joint contributions
2 & 4	.01424
2 & 3	.11183
2 & 5	.00544
4 & 6	-.00843
4 & 3	.01468
3 & 5	-.00433
3,4 & 5	.00211
2,3 & 4	.02103
2,4 & 5	-.00403
2,3 & 5	.00194
2,3,4 & 5	-.00286
Total (R^2)	.70376

	Independent contributions
Winnipeg	
2. Occupational index	.29908
3. Percentage of interprov. migrants	.04470
4. Female participation rate	.13777
5. Percentage dwell. occ. more than 10 yrs.	.01390
	Joint contributions
2 & 4	.05036
2 & 3	-.03801
2 & 5	.03617
4 & 5	-.01333
4 & 3	.15215
3 & 5	.06179
3,4 & 5	.01440
2,3 & 4	-.13520
2,4 & 5	-.02162
2,3 & 5	-.06672
2,3,4 & 5	.02599
Total (R^2)	.56142

(1) See table 4.1 for complete list of variables.

remaining variables. But the independent contribution of the percentage of married women is actually trivial. It will be noticeable in an equation that also includes the female participation rate and either the occupational index or the migration variable. But when both of these variables are present, they will draw off all the effect of the percentage of married women.

Many of these relatively large joint contributions in Calgary are negative, which means that the combined effect of the two, three, or four variables involved reduces the independent contribution of one of them. The explanation is that the direction in which these variables vary with each other is opposite to their direction of variation with the fertility ratio. The female participation rate, for example, varies directly with the occupational index but inversely with fertility. Thus in predominantly working class districts, where fertility is high, a higher proportion of women are in the labour force, resulting in lower fertility. Despite the apparent paradox, this may be a perfectly realistic description of the fertility pattern: if it were not for the effect of female employment, the relationship between the proportion of blue-collar workers and the fertility ratio might be even stronger.

In another set of opposing relationships, the occupational index and the percentage of migrants from outside the province are both positively correlated with fertility but are negatively associated with each other. Migrants to metropolitan areas generally are educated people working in highly skilled occupations, so it is not surprising that they would not move to primarily working-class districts. On the other hand, such people probably <u>are</u> attracted to suburbs and other residential areas where the physical environment is conducive to child-rearing and current fertility is high.

For Halifax, a different set of variables has been selected: the female schooling index, the female labour force participation rate, the percentage of married women among women aged 15-24, and the percentage of persons of British origin. Here the independent contributions amount to only 25% of R^2. The percentage of persons of British origin makes the largest independent contribution, and may also be transmitting the effect of the female schooling index, with which it makes a joint contribution of .19445. The variable with the second largest independent contribution, the female participation rate is associated with the

fourth most important variable, the percentage of married women aged 15-24. The two make a joint contribution of .12577. The schooling index and the percentage of married women make a weak contribution, amounting to only 10% of explained variation.

In Montréal, we again find three of the four factors used in Calgary: the male occupational index, the female labour force participation rate, and the percentage of migrants from outside the province. The fourth variable is the percentage of elderly persons. The four variables explain only 40% of the variation in fertility; their independent contributions amount to 53.6% of R^2. The most important variable is the occupational index, which accounts for 66.4% of the total independent contributions. The joint contributions of the female participation rate with the occupational index and the percentage of migrants from outside the province (.08194 and .06326 respectively) show that its effect is conveyed through these two variables. The influence of the percentage of elderly persons is exerted entirely through its correlations with the other variables.

Two negative joint contributions are also found in Montréal, representing the same type of offsetting relationships that were observed in Calgary. The joint contribution of the occupational index and the percentage of migrants from outside the province is -.03498; that of the occupational index, the female participation rate, and the migration variable is -.05152. Again the negative effect exerted on fertility by female employment counterbalances the positive effect of the occupational index. The negative association between the occupational index and the percentage of migrants from outside the province (both positively correlated with fertility) has also been observed earlier in this study. The relationship between fertility and the occupational index seems to indicate that the populations of working-class neighbourhoods tend to have higher fertility ratios. But the positive association between the migration variable and the fertility ratio more probably results from the attraction that certain types of neighbourhoods have for mobile young families. In all likelihood these will not be predominantly working-class areas.

Turning now to Ottawa, we find the following four indicator variables: the percentage of dwellings constructed after 1945, the male occupational index, the female schooling index, and the percentage of married women among women aged

15-24. The proportion of variation explained is very high (72%) but only 22% of the explanation consists of independent contributions. The occupational index is first in order of importance, with an independent contribution equal to 50% of the four. Among the joint contributions, those made by the housing variable and the schooling index (.19557) and by the occupational and schooling indexes (.30967) are the largest. They indicate that the schooling index transmits the effect of the housing variable, while the occupational index acts largely in conjunction with the schooling index (which increases with the number of less educated persons in the population). There are two negative joint contributions, one made by the housing variable and the occupational index (-.02232), the other by the housing variable, the occupational index, and the schooling index. These negative values result from the inverse association between the occupational index and the percentage of dwellings constructed after 1945, both of which are positively correlated with fertility. Their negative relationship of course reduces the explanation available from these two variables. The reason for it is that many houses, constructed after 1945 are single-family dwellings in suburban neighbourhoods, attractive to young families with several children, but often too expensive for the working class.

In Toronto, 58% of the variation in fertility is explained by the four selected variables; these are the female labour force participation rate, the male occupational index, the percentage of migrants from outside the province, and the percentage of single persons. Nearly all of the statistical explanation - 92% - consists of independent contributions. The occupational index is first in importance, but the percentage of migrants from outside the province is very close behind. Next comes the female participation rate, and finally the percentage of single persons, which makes a rather small contribution. The number of negative joint contributions is particularly large. Once more, the female participation rate is working against the positive effect of the occupational index on fertility. Also, although in Toronto there is almost no correlation between the occupational index and the percentage of migrants from outside the province, when all four factors are included in the equation the joint effect of these two is again negative, if rather weak. The percentage of single persons, because of its negative correlation with fertility, also attenuates the influence of the other variables. This percentage decreases as the percentage of migrants increases, which confirms the hypothesis that migrants are attracted to areas with housing suitable for families while single people prefer a different environment - downtown neighbour-

hoods where small apartments are available. We should note, however, that in combination with the female participation rate, the effect of these last two variables on fertility is positive. The pattern of relationships is thus complex and difficult to interpret precisely. Some factors absent from the equation might also be at work.

Now we shall discuss the correlations between the variables and the fertility ratio in Vancouver. The set of indicator variables is the same as in Toronto, except that the percentage of dwellings occupied for more than 10 years replaces the percentage of single persons. Explained variation is 70% of total variation, and more than 75% of this explanation consists of independent contributions. The female participation rate is by far the most important factor, with the occupational index coming second and the percentage of migrants from outside the province third. There is only one sizable joint contribution (.11183) made by the occupational index and the female participation rate, which shows how strong an influence the latter exerts.

In the seventh metropolitan area, Winnipeg, the variables are exactly the same as those used in Vancouver but explain only 56% of the variation in fertility. The occupational index comes first in order of importance, the female participation rate second. The joint contributions are large, particularly that made by the participation rate and the migration variable. A strong negative joint contribution (-.13520) also appears, made by the occupational index, the migration variable, and the participation rate. It results from the combined effect of the first two variables: they are correlated positively with fertility, but negatively with each other, so each curbs the other's influence on the dependent variable.

4.4. Comparison of 1961 Results for the Seven Metropolitan Areas

The results for the seven metropolitan areas can be compared using Table 4.5. For each area this table gives the independent contributions of the four factors and their total joint contribution all expressed as percentages of explained variation (R^2).

As this table shows, there are five areas in which the male occupational index, the female participation rate, and the percentage of migrants from outside the province all appear as indicator variables. This uniformity is to be expected,

TABLE 4.5. Order of Importance of Selected Socio-economic Variables in the Correlation with Fertility in Seven Metropolitan Areas, 1961

Metropolitan area and variables[1]	Independent contribution		Joint contributions
	Independent contribution	Order of importance	
	per cent		per cent
Calgary			
Female participation rate	24.4	1	
Percentage of interprov. migrants	8.7	2	
Occupational index	8.5	3	57.7
Percentage of married women aged 15-24	-	4	
Halifax			
Percentage of British origin	12.9	1	
Female participation rate	5.3	2	
Percentage of married women aged 15-24	3.5	3	75.1
Schooling index	3.3	4	
Montréal			
Occupational index	35.6	1	
Female participation rate	8.9	2	
Percentage of interprov. migrants	8.9	3	46.4
Percentage of elderly	0.2	4	
Ottawa			
Occupational index	10.7	1	
Schooling index	6.3	2	
Percentage of dwell. built after 1945	3.6	3	78.3
Percentage of married women aged 15-24	1.1	4	
Toronto			
Occupational index	31.5	1	
Percentage of interprov. migrants	31.4	2	
Female participation rate	22.2	3	8.3
Percentage single	6.6	4	
Vancouver			
Female participation rate	64.5	1	
Occupational index	8.3	2	
Percentage of interprov. migrants	4.1	3	21.6
Percentage of dwell. occ. more than 10 years	1.5	4	
Winnipeg			
Occupational index	53.3	1	
Female participation rate	24.5	2	
Percentage of interprov. migrants	8.0	3	11.7
Percentage of dwell. occ. more than 10 years	2.5	4	

(1) See Table 4.1 for complete list of variables.

because in the selection process for 1961, when two variables in a cluster were both fairly strongly correlated with fertility or relatively representative of the group, the one that had already been used for another city was sometimes selected for this very reason. The selection criteria for 1961 were thus more flexible than those for 1971, leaving room for the human judgment that is reflected in the choice of indicators.

In Toronto, Vancouver, and Winnipeg, the selected variables are not strongly interrelated, so their independent contributions represent most of the statistical explanation. Thus it is in these cities that the experimental design has been most successful. The variables form relatively independent clusters from which we can select the factors most likely to make large independent contributions to the explanation of variation in fertility.

In the five cities where the three indicator variables mentioned above appear, adding the fourth variable to the equation increases explained variation only very slightly. The largest contribution for a fourth variable is seen in Toronto, where the percentage of single persons accounts for 6% of explained variation. The predominant factors in most of the metropolitan areas are the male occupational index and the female participation rate.

Further information can be gleaned from the squared multiple correlation coefficient by analysing the underlying mechanisms that cause the total joint contributions in a city to be positive or negative. The general patterns revealed by such an analysis are as follows. Current fertility is positively correlated with the occupational index (which increases with the proportion of blue-collar workers in an area) and with the percentage of migrants from outside the province. But fertility is negatively related to the female participation rate, and this association counterbalances the positive effect of the occupational index on fertility. The positive influence of the occupational index is also weakened by its negative relationship with the proportion of migrants, although the latter factor is also positively associated with fertility.

The pattern of relationships just described suggests that there are two types of neighbourhood that favour fertility: working-class districts, and areas attractive to mobile families. The characteristics positively influencing ferti-

lity in the one type of area, however, are incompatible with those that do so in the other. In working-class neighbourhoods the average number of children born is relatively high, but more women tend to work, so the fertility ratio is lower than it would otherwise be. Such neighbourhoods are less attractive to families from other provinces, probably because so many migrants are skilled professionals. In the neighbourhoods that <u>are</u> attractive to such families, a lower proportion of women are employed, which raises average fertility.

Associations of these kinds may be observed in a few metropolitan areas such as Montréal and Toronto. A systematic investigation to confirm these findings would probably be worthwhile.

CHAPTER 5

COMPARISON OF 1961 AND 1971 RESULTS AND CONCLUSION

The two preceding chapters present the results of a statistical analysis of socio-economic correlates of fertility in seven Canadian metropolitan areas, based on data from the 1961 and 1971 censuses. The unit of analysis is the census tract rather than the individual, and the results that will now be compared deal with the relationship between the socio-economic characteristics of census tracts and variations in their average fertility.

The seven metropolitan areas should first be compared in terms of their overall fertility levels. Fertility as measured by the ratio of children aged 0-4 to women aged 15-44 (in other words, fertility for the five years preceding each census) dropped sharply from 1961 to 1971, as can be seen from Table 5.1.

TABLE 5.1. Child-woman Ratios for Seven Metropolitan Areas of Canada, 1961 and 1971

Metropolitan area	1961	1971	
		Ratio	Decline 1961 to 1971
			per cent
Calgary	842	570	32.3
Halifax	868	593	31.7
Montréal	792	528	33.3
Ottawa	849	554	34.7
Toronto	692	519	25.0
Vancouver	729	511	29.9
Winnipeg	753	567	24.7

In the metropolitan areas east of Toronto, fertility declined by more than 30%; in the areas west of Toronto, the decrease was between 25% and 30%, and these areas already had slightly lower fertility ratios in 1961.

Although fertility levels fell off sharply over the decade, the amount of relative variation within each area remained about the same, the coefficients of variation ranging from 20% to 25%.

Turning now to the socio-economic correlates of fertility, we observe in the 1961 results a grouping composed of cultural variables and economic variables; this same grouping is found in 1971, but the correlation coefficients are somewhat lower. A second grouping is also found in 1971, consisting of a fairly homegeneous set of variables indicating whether a census tract is more attractive to families or to people without children and people living alone. This grouping did not appear in 1961. Its emergence by the end of the decade probably reflects the geographic expansion of metropolitan areas to include new housing developments designed principally for families.

The multiple correlation analyses clearly show that by the end of the decade the socio-economic indexes had lost much of their ability to explain variations in fertility. This fact is illustrated in Table 5.2, which gives the multiple correlation coefficients and their squared values for each metropolitan area for 1961 and 1971.

In every metropolitan area, the percentage of variation explained is lower in 1971. Because the somewhat different criteria used to select the 1971 variables would result in higher squared multiple correlation coefficients if all other things remained equal, it can be concluded that the relationship between socio-economic differences and differences in fertility actually grew weaker in the course of the 1960s. Such a change probably reflects on important trend in society at large - a convergence of values and attitudes concerning child-bearing and family size.

The next step in the comparison will be to see how successfully the variables for each year reveal distinct dimensions of the environment under consideration, the census tract. Such success is measured by the percentage that the

independent contributions of these variables represents in the total explained variation in fertility; the percentages for the seven areas and both years are given in Table 5.3.

TABLE 5.2. Multiple Correlation Coefficients(1) and Squared Multiple Correlation Coefficients for Seven Metropolitan Areas of Canada, 1961 and 1971

Metropolitan area	1961		1971	
	R	R^2	R	R^2
Calgary	.967	.936	.752	.566
Halifax	.835	.696	.637	.405
Montréal	.631	.398	.563	.317
Ottawa	.846	.716	.392	.154
Toronto	.763	.582	.666	.444
Vancouver	.839	.704	.699	.490
Winnipeg	.749	.561	.416	.173

(1) Each of the independent variables in each multiple correlation represents a cluster of independent variables of which it is the member having the highest coefficient of correlation with the fertility ratio.

TABLE 5.3. Independent Contributions of Socio-economic Variables as a Percentage of Total Explained Variation in Fertility (R^2), for Seven Metropolitan Areas of Canada, 1961 and 1971

Metropolitan area	1961	1971
Calgary	42.3	78.2
Halifax	24.9	41.1
Montréal	53.6	46.0
Ottawa	21.7	44.4
Toronto	91.7	87.6
Vancouver	78.4	55.5
Winnipeg	88.3	59.6

As the above table shows, the relative importance of the independent contributions has changed from 1961 to 1971 in every metropolitan area except Toronto, where they represent a high proportion of explained vairation in both years (92% in 1961 and 88% in 1971). The 1971 figures are slightly more uniform, however, with the percentages for five of the areas falling between 40% and 60%. These results indicate that the phenomena measured by the variables remain closely interrelated and that the joint effects of these variables on fertility must therefore still be included in the analysis.

The analyses just discussed show that the pattern of relationships between environment and fertility differs from city to city. The types of environment favourable to fertility are predominantly working-class neighbourhoods and suburban neighbourhoods where the type of housing attracts families with children. The environments not favourable to fertility are those where people without families prefer to live and where a high proportion of women are in the labour force. But the separate effects of two socio-economic characteristics of an area are often attenuated by their combined effects. For example, the 1961 analysis shows that the joint effect of the female labour force participation rate and the occupational ("blue-collar") index on fertility was negative, because the female participation rate grows as the percentage of blue-collar workers does, and the negative impact of the former offsets the positive impact of the latter.

In the 1971 analysis, the role of the female labour force participation rate could not be evaluated because this variable did not meet the various empirical selection criteria. Instead, it was the percentage of owner-occupied dwellings that acted to offset another variable; although both this percentage and the occupational index are positively associated with fertility, they are negatively related to each other, so the positive influence on fertility is curtailed.

In order to determine how large an effect the female participation rate did have on fertility in 1971, this variable has been introduced into a multiple correlation that also includes the occupational index, the percentage of owner-occupied dwellings, and the percentage of migrants from outside the province. The results for the three largest metropolitan areas in Canada are given in Table 5.4.

As the above table shows, in the specified combination of independent variables, the female labour force participation rate accounts for a large

TABLE 5.4. Independent Contribution of the Female Labour Force Participation Rate to the Explanation of Variation in Fertility, Three Metropolitan Areas of Canada, 1971

Variables[1]	Montréal	Toronto	Vancouver
Total	100.0	100.0	100.0
Female participation rate	40.8	51.8	18.1
Occupational index	25.6	32.3	29.1
Percentage of owner-occ. dwell.	0.3	0.2	8.2
Percentage of interprov. migrants	33.9	12.6	13.4
Joint contributions	- 0.6	3.1	31.2
R^2	0.340	0.410	0.618

(1) See Table 2.10 for complete list of variables.

percentage of the explained variation in fertility; the relative importance of this independent variable has increased since 1961. (The other three variables are roughly the same ones used for that year.) The percentage of total variation explained is lower, but the joint contributions constitute a smaller proportion of this percentage. In absolute value, however, the joint contributions are far from negligible, particularly in Vancouver. The influence of the female participation rate was not evident from the 1961 analysis, because this variable was generally too closely correlated with others that met the selection criteria. Its effect was therefore manifested by the variable representing the cluster to which it belonged. Thus we again see that two or three variables can provide most of the statistical explanation for variation in fertility.

The relationships revealed by this study are so diverse that it is difficult to detect persistent patterns among them. Nevertheless, two conclusions can definitely be drawn:

(a) from 1961 to 1971, the socio-economic variables used in this study became less effective as tools for explaining differences in the average fertility of census tracts; and

(b) these variables reflect two principal dimensions of the census tract: the social environment as such, and the physical environment (the type of housing in the area). Neither dimension clearly predominates in the seven cities or in the two years considered in this study; a change in the variable used to represent one of these dimensions may reverse their order of importance.

Because the minimum correlation coefficients and other criteria used to select the variables for this analysis were necessarily arbitrary, it is impossible to draw any more definite conclusion than that these two dimensions do appear. The initial goal of this study was to evaluate four aspects of community life: the cultural, the social, the economic, and the "ecological". But it was soon found that cultural factors were inextricably linked with economic factors, and further investigation revealed that the social and ecological factors were also interrelated.

Having found that the set of factors characterizing the census tract resolves itself into two dimensions, we are led back to the question that originally inspired this study: does the environment influence fertility? The answer remains uncertain: there is some association between environment and fertility, since a certain proportion of the variation in fertility (a relatively large proportion for 1961, a smaller one for 1971) is related to the characteristics of the environment. The unit of analysis for this study, the census tract, is intended to represent the environment in which people live, and the results indicate that certain types of environment are more favourable to fertility than others. But this relationship probably reflects decisions made by young couples to live in environments where they can best raise families, rather than an actual milieu effect such that the environment itself causes couples to have more children. Such an effect may actually exist, but the present data are insufficient to confirm that it does. In order to make such a determination, it would be necessary to have data on individuals, as well as on the environments in which they live.

In conclusion, it should be said that the results of this empirical analysis raise some doubts about the possibility of uncovering the fundamental patterns in complex social relationships. The most important determinant of the order

of importance of the indicator variables seems to be the criterion by which they are chosen. When several indexes are closely interrelated, having high coefficients of correlation with each other, the results are more reliable, but when the correlations within a cluster are in the 0.5 to 0.7 range, the order of importance of this group will depend on which variable is used to represent it. Because this is so, any conclusion about the order of importance of the variables in the explanation of variations in fertility must remain tentative.

APPENDIX A

TECHNIQUE USED TO GROUP THE VARIABLES

A.1. Introduction

In an analysis of the relationships between the social, economic, cultural and ecological environment and a demographic phenomenon such as fertility, a great many variables must be included if the numerous characteristics of this environment are to be adequately represented. The analyst may be confronted with a wide range of variables, indexes and other measures that represent the many aspects of community life. Many of them may already have proven significant in explaining variations in the phenomenon being studied. But often there will be some redundancy among these measures, and in any case analytical methods have certain limitations. Multiple regression and correlation analysis in particular is more effective when the variables are selected so as to reveal the specific underlying dimensions of the human community in question[1]. From all the variables available, the analyst must therefore choose a limited number that reduce reality to its most essential dimensions.

There are two ways of reducing the variables into a manageable number of groups: the conceptual method and the empirical method[2]. In the conceptual method, a theoretical construct is used to determine which social dimensions have the most important relationships to the phenomenon under consideration. Indexes characterizing these dimensions are selected and used in the subsequent analysis.

In the empirical method, a large number of indexes that can be calculated from the data available are chosen on some theoretical basis. These indexes are then grouped according to some predetermined objective criterion in order to determine the principal dimensions that they represent. Many authors have found that the dimensions determined using this empirical approach are not unlike those revealed by the conceptual technique.

The empirical approach was chosen for the present study. The specific technique used is adapted from that presented by Leroy Stone in Migration in

See footnote(s) on page 91.

Canada: Some Regional Aspects; Stone's technique in turn draws on work by Tryon, Harman, and Holzinger.

A.2. Basic Grouping Principles

The first basic principle for grouping a large number of variables into a small number of clusters is that the variables within a cluster should be highly correlated with each other. If variables are highly correlated with each other, they should follow similar patterns of correlation with the other variables chosen, so the second grouping principle is that the correlation profiles of variables in the same cluster should be similar. The correlation profile of a variable consists of its coefficients of simple correlation with the other variables. Profiles are considered similar if their graphs show peaks and troughs for the same variables, which means that these profiles are linearly related.

The actual grouping procedure consists in assigning variables to clusters according to the degree of similarity of their correlation profiles. When the grouping is complete, Holzinger's B-coefficient is calculated for each cluster as an independent test of whether it satisfies the basic criterion of high intra-cluster correlation.

A.3. Algorithm for Grouping the Variables

A. After the value of each variable has been calculated for each unit of observation (in this study, the census tract), the matrix of simple correlation coefficients is established. Each row in the matrix represents a correlation profile.

B. The matrix of simple correlation coefficients is then used to generate a second matrix, consisting of the coefficients of correlation between the profiles. The coefficient of correlation between any two profiles should be a significant measure of their degree of similarity, since the more similar they are (according to the definition given above) the higher the correlation between them will be.

C. (Step C is illustrated in detail in the flow chart at the end of this appendix.) The elements of the second matrix (excluding those in the diagonals) are inspected, and two variables i and j whose profiles have a correlation

coefficient of .90 or more are chosen to be the initial members of the first cluster.

Next, this matrix is again examined and another pair of variables with a profile coefficient of .90 or more is selected to begin the second cluster. The same procedure is then followed as for the first cluster.

This process is repeated until all the variables have been assigned to clusters or until there are no more pairs of variables with a profile correlation coefficient of at least .90. If no variables are left unassigned, the B-coefficient test is applied to each cluster. If some variables are left over, the minimum level for the profile correlation coefficient is dropped to .880, the process is continued until a satisfactory grouping is achieved. The B-coefficient test is then applied.

D. Holzinger's B-coefficient is a good test of the validity of the grouping, because it tells us whether the variables in each cluster are more closely correlated with each other than with the variables outside the cluster. The formula for this coefficient is as follows:

$$B = \frac{200\ (n - v)\ S}{(v - 1)\ T}$$

where: B is Holzinger's B-coefficient;

n is the total number of variables

v is the number of variables in the cluster;

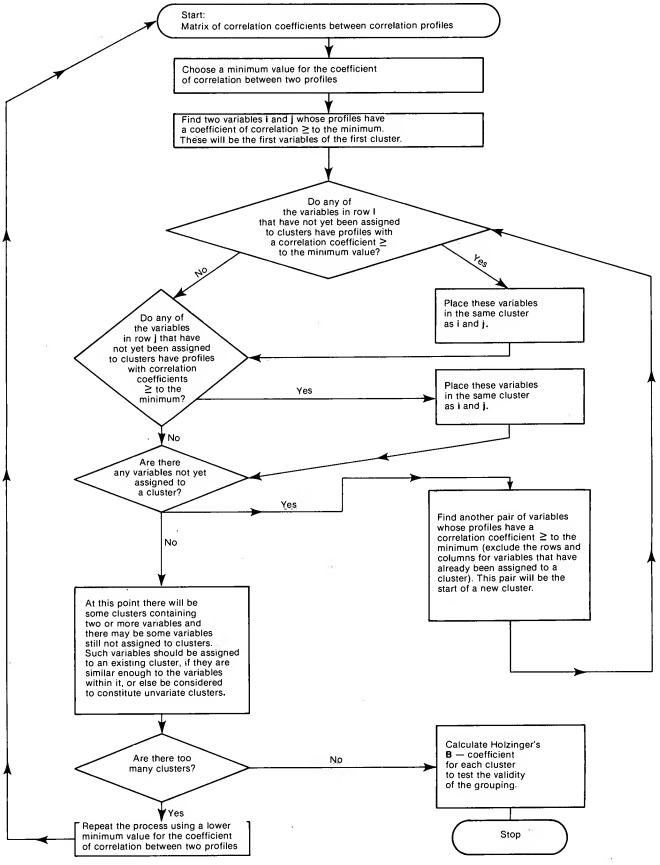
S is the sum of the coefficients of correlation between the variables in the cluster; and

T is the sum of the coefficients of correlation between the variables in the cluster and those outside the cluster.

This formula and its justification can be found on page 128 of Modern Factor Analysis by Harry Harman (second edition).

Figure 1.A.

Flow Chart for Grouping Variables



FOOTNOTES

(1) See on this subject Leroy O. Stone, Migration in Canada: Some Regional Aspects, pp. 247-274, 353-359.

(2) On this subject see Robert C. Tryon and Daniel E. Bailey, Cluster Analysis, pp. 45-49.

APPENDIX B

FORMULAS FOR VARIABLES, 1961 AND 1971, AND DATA SOURCES

Formulas for socio-economic variables used to analyse 1961 census data

Variable	Method of calculation
Percentage of Catholics	(Number of Catholics/total population) x 100
Percentage of persons of British ethnic origin	(Number of persons of British origin/total population) x 100
Percentage of owner-occupied dwellings	(Number of owner-occupied dwellings/total number of households) x 100
Percentage of dwellings occupied for more than 10 years	(Number of dwellings occupied for more than 10 years/total number of households) x 100
Percentage of dwellings built after 1945	(Number of dwellings built after 1945/total number of households) x 100
Female labour force participation rate	(Number of women in labour force/number of women aged 15 and over) x 100
Male occupational index	[(Male workers in primary sector + male craftsmen + male labourers)/male labour force] x 100
Percentage of married women among women aged 15-24	(Number of married women aged 15-24/total number of women aged 15-24) x 100
Percentage of migrants from outside province	[Migrants from elsewhere in Canada (excludes movers within same metropolitan area) - migrants within same province + migrants from outside Canada/total population aged 5 and over] x 100
Percentage of migrants within same province	(Number of migrants within same province/total population aged 5 and over) x 100
School attendance rate of women	(Number of women aged 15-24 attending school/total number of women aged 15-24) x 100
Percentage of persons with English as mother tongue	(Number of persons with English as mother tongue/total population) x 100
Average income of head of household	
Percentage of single persons	(Number of single persons aged 15 and over/total population aged 15 and over) x 100
Percentage of divorced persons	(Number of divorced persons/number of married persons) x 100
Percentage of elderly persons	(Number of persons aged 65 and over/number of persons aged 15 and over) x 100
Percentage of persons born outside Canada	(Number of persons born outside Canada/total population) x 100
Female schooling index	[(Females with no schooling - females aged 0-4 + females with 1 or more years of elementary schooling + females with 1 to 2 years of secondary schooling - females with 1 or more years of university education)/female population aged 5 and over not attending school] x 100
Average rent	
Percentage of crowded dwellings	(Number of crowded dwellings/total number of households) x 100

The 1961 census data were taken from the census tract bulletins.

Differences in the socio-economic variables
used for 1971 data

Percentage of English speakers (English most often spoken at home)	(Population who speaks English most often at home/ total population) x 100
School attendance rate	(Population aged 15-24 attending school/total population aged 15-24) x 100
Schooling index (population not attending school)	[(Population with no schooling - population aged 0-4 + population with 1 or more years of elementary schooling + population with 1 or 2 years of secondary schooling - population with 1 or more years of university education)/population aged 5 and over not attending school] x 100
Male occupational index:	(Sum of male population in the following occupational groups: (a) farming (b) fishing, hunting and trapping (c) forestry and logging (d) mining and quarrying, including oil and gas field occupations (e) raw materials processing (f) equipment operating (g) fabricating, assembling and repairing (h) construction (i) transport (j) packaging and material handling (k) other divided by total males in labour force) x 100

The 1971 census data were taken from the census tract summary tapes.

APPENDIX C

RANDOM VARIATION IN THE CHILD-WOMAN RATIO

There are two types of random error associated with the calculation of the child-woman ratio: sampling error and error due to random rounding.

C.1. Sampling Error

For the 1971 census, the question concerning number of children ever born was asked of a one-third sample of the female population. The variation in the child-woman ratios for census tracts in 1971 may therefore reflect some sampling error. The smaller the number of women questioned in the tract, the larger this error will be. A calculation made for this study showed that for each census tract, there must be at least 118 women who have answered this question.if the child-woman ratio is to be estimated with a 95% level of confidence. Since eliminating all tracts with fewer than 118 such women would have substantially decreased the coverage of this study, a confidence level of 94% was chosen instead, for which the minimum number of women would be 81. Ultimately, a minimum of 100 women answering the question, or 300 women per tract, was decided upon. The tracts thereby eliminated in each metropolitan area are listed below:

Calgary (1)	2
Halifax (5)	5-7-9-13-27
Montreal (96)	10-23-32-38-41-42-43-45-47-49 to 70-73-77-80-85-95-103-106-107-109-114-121-134-140 to 143-148-153-154-160-162-166-173-192-214-225-246-268-288-309-315-316-350-352-355-356-360-361-362-385-392-402-414-491-500-560-585-631-644-653-654-578-680-681-750-751-757-758-775-778-875-888-903-926-927-928-931
Toronto (50)	1-2-6-9-11-14-15-16-20-34-35-61-64-88-89-106-120-121-123-140-157-186-188-192-202-205-210-218-224-226 to 229-242-264-265-266-296-347-440-506-516-517-527-562-580-600-605-612-806
Vancouver (20)	1-20-22-58-59-66-70-119-150-201-202-206-207-220-232-250-255-270-280-420
Winnipeg (11)	13-24-33-36-51-52-100-140-530-532-541

C.2. Error Due to Random Rounding

The data for 1971 came from the census tract summary tapes. The number of women ever married age 15 to 44 in each tract had to be calculated by cumulating the 28 cells of the table showing the number of women ever married classified by age group and number of live-born children. This table appears in file B2 DEM B03. Since each cell has been rounded to end in 0 or 5, the cumulative error in this study could be fairly high for census tracts with a relatively low female population.

It is possible, however, to calculate a confidence interval for such cumulative figures according to the number of cells cumulated[1]. For a figure based on 28 cells, the limits of the 95% confidence interval are +20 and -20; the 99% interval has limits of +30 and -30. For this study, the variation due to random rounding should in any case be relatively low, because all census tracts with fewer than 300 women have been excluded.

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(1) The method of calculation is taken from Claude Dionne, "Evaluation des intervalles de confiance selon le nombre de cellules agrégées dans les données arrondies du recensement" (mimeographed).

APPENDIX D

EQUATIONS FOR ESTIMATION OF THE INDEPENDENT AND JOINT CONTRIBUTIONS MADE BY INDEPENDENT VARIABLES TO THE STATISTICAL EXPLANATION OF VARIATION IN A DEPENDENT VARIABLE

Example: Multiple correlation with four independent variables ($R^2_{1.jklm}$)

Independent contributions:

j	$Q_1 = R^2_{i.jklm} - R^2_{i.klm}$
k	$Q_2 = R^2_{i.jklm} - R^2_{i.jlm}$
l	$Q_3 = R^2_{i.jklm} - R^2_{i.jkm}$
m	$Q_4 = R^2_{i.jklm} - R^2_{i.jkl}$

Joint contributions:

j and l	$Q_5 = R^2_{i.jkm} - R^2_{i.km} - Q_1$
j and k	$Q_6 = R^2_{i.jlm} - R^2_{i.lm} - Q_1$
j and m	$Q_7 = R^2_{i.jkl} - R^2_{i.kl} - Q_1$
l and m	$Q_8 = R^2_{i.jkl} - R^2_{i.jk} - Q_3$
l and k	$Q_9 = R^2_{i.jlm} - R^2_{i.jm} - Q_3$
k and m	$Q_{10} = R^2_{i.jkl} - R^2_{i.jl} - Q_2$
k, l and m	$Q_{11} = R^2_{i.jk} - R^2_{i.j} - Q_2 - Q_9 - Q_{10}$
j, k and l	$Q_{12} = R^2_{i.jm} - R^2_{im} - Q_1 - Q_6 - Q_5$
j, l and m	$Q_{13} = R^2_{i.jk} - R^2_{ik} - Q_1 - Q_7 - Q_5$

j, k and m $\quad Q_{14} = R^2_{i.jl} - R^2_{il} - Q_1 - Q_6 - Q_7$

j, k. l and m $\quad Q_{15} = R^2_{ij} - Q_1 - Q_6 - Q_5 - Q_7 - Q_{14} - Q_{12} - Q_{13}$

Q_1 to Q_4 must have positive values

Q_5 to Q_{15} may have negative values

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